WATER WORKS & SEWERAGE

A GILLETTE PUBLICATION

Vol. 86, No. 9 SEPTEMBER, 1939 L. H. Enslow Editor

INCINERATORS
BUILT BY NICHOLS
whether for burning sewage sludge, garbage, rubbish, or any combination of these, offer large or small communities a sanitary, efficient and economical method of reducing to harmless mineral ash all matter which might be dangerous to health or become a public nuisance.

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NERCO

60 WALL TOWER BLDG. NEW YORK, N. Y.

Anyway you check it — beam strength, impact strength, crushing strength — cast iron pipe gives you ample margins of safety—*plus* long life, low maintenance and lowest cost per service year. We furnish U. S. Cast Iron Pipe any way you want it — pit cast or centrifugally cast by the Super-de Lavaud chill-free process — with bell-and-spigot, mechanical and flanged joints, or with plain or threaded ends.

U.S. cast iron PIPE

for water works, gas, sewerage, drainage and industrial services.

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General Offices, Burlington, N. J.

Plants and Sales Offices throughout the U. S. A.

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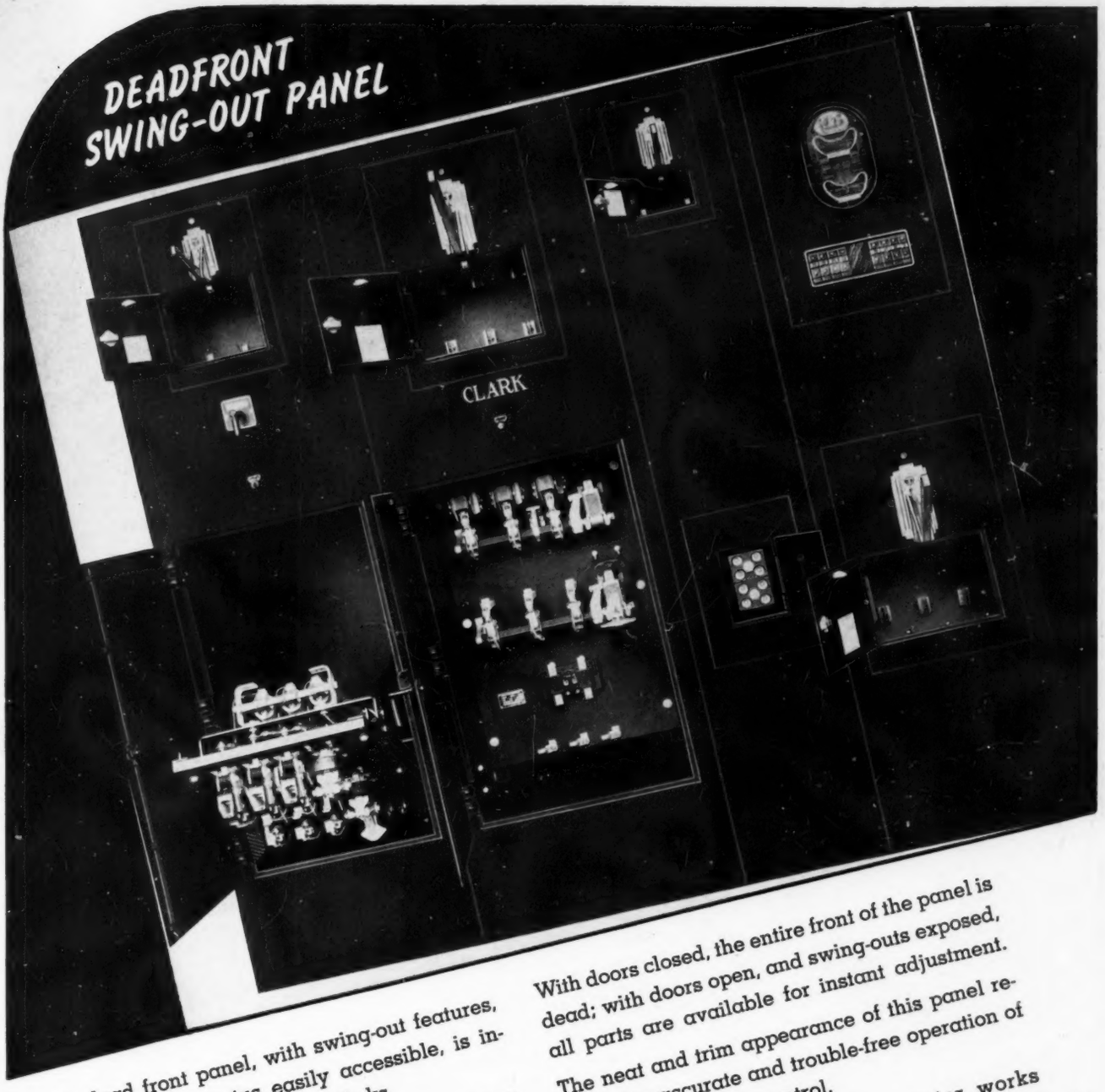


This dead front panel, with swing-out features, making all apparatus easily accessible, is installed in an Eastern Water Works.

It controls 1—30 H.P. and 1—50 H.P., 220 volt, 3 phase, 60 cycle, 3600 r.p.m. motors, which are operated by Telemeters.

In addition to the motor control equipment, this panel includes incoming line panel with metering equipment, and a lighting distribution panel.

With doors closed, the entire front of the panel is dead; with doors open, and swing-outs exposed, all parts are available for instant adjustment.

The neat and trim appearance of this panel reflects the accurate and trouble-free operation of the "3C" electrical control.

For all electric motor-driven water works and sewage pumping plants, Clark "3C" controls are available.

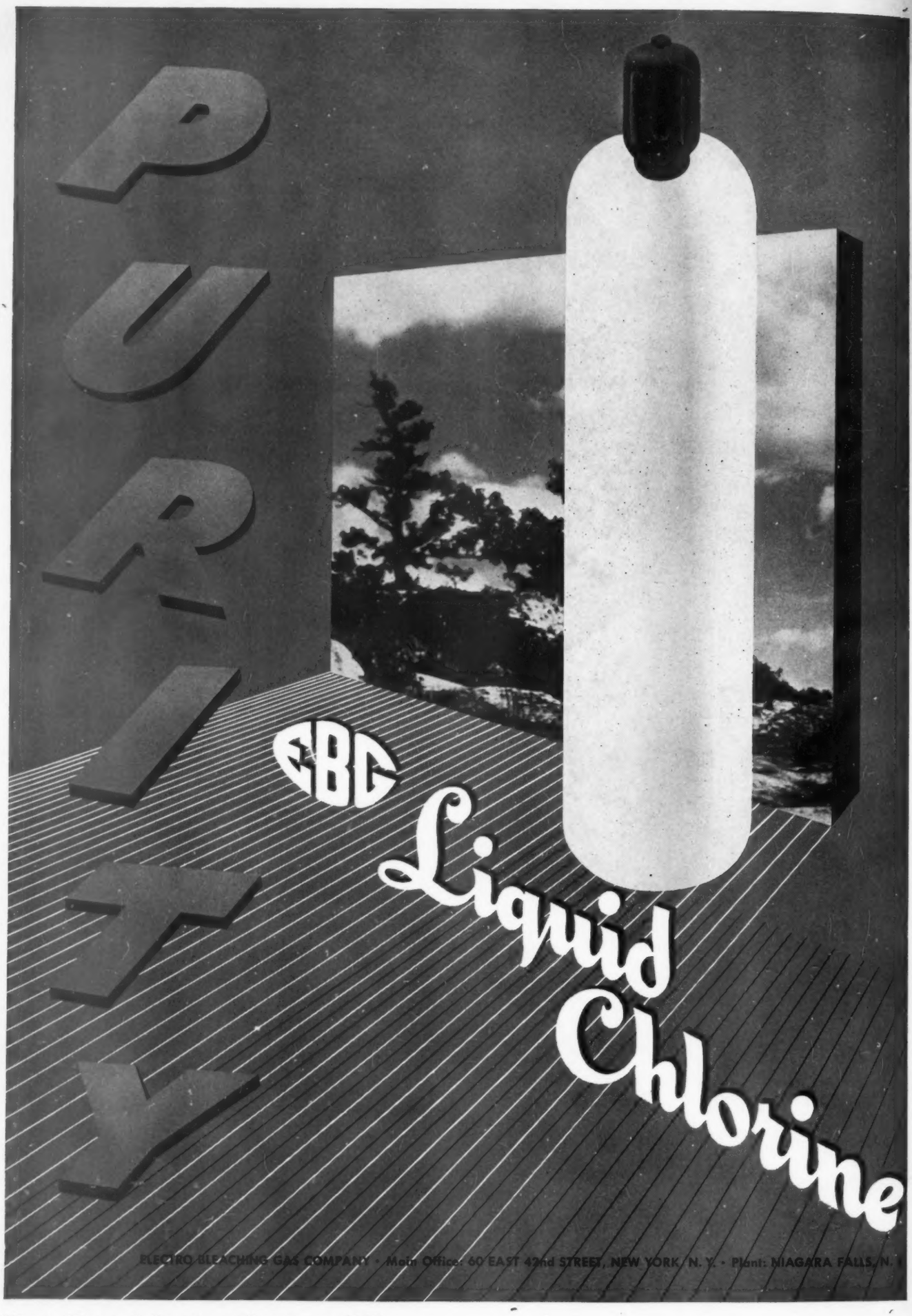
Our nearest office or agency will gladly consult with you.

OFFICES IN PRINCIPAL CITIES

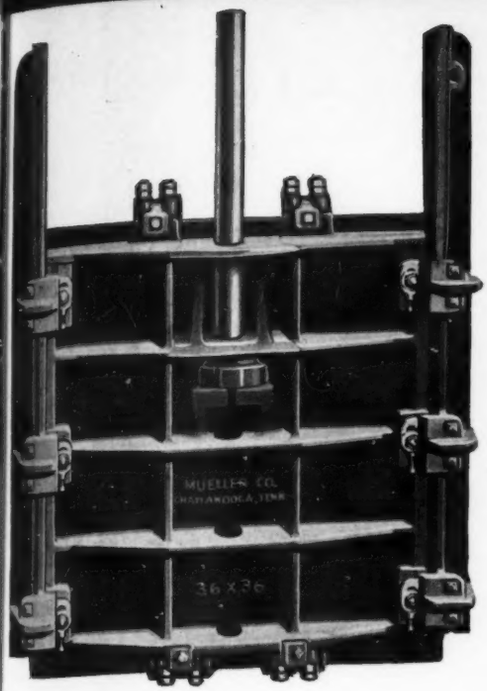
THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

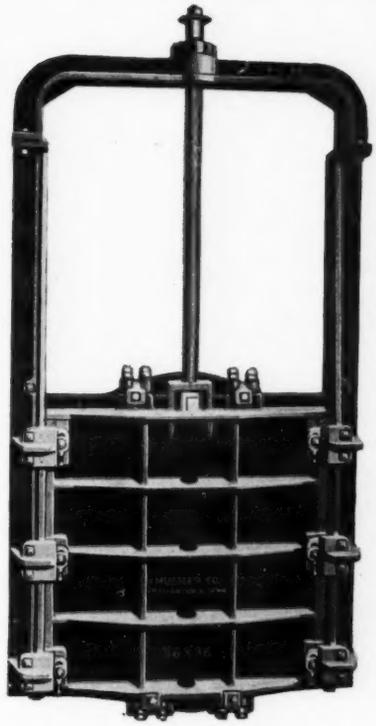
WATER WORKS AND SEWERAGE, September, 1939. Volume 86. Number 9. Published monthly at 330 South Wells Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate. United States and Canada, $2.00 per year; Foreign, $3.00 per year. Copyright, 1939. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under Act of March 3, 1879.


PURITY
EBG
Liquid Chlorine
ELECTRO BLEACHING GAS COMPANY · Main Office: 60 EAST 42nd STREET, NEW YORK, N. Y. · Plant: NIAGARA FALLS, N. Y.

SLUICE GATES



Many engineers find that they can fill their Sluice Gate requirements out of the Mueller-Columbian regular line. Sizes up to 96 by 96 inches are available and may be had with either circular or rectangular opening, rising or non-rising stem, and for either seating or un-seating pressure and to fit any type of connection. They may be operated manually, with hydraulic cylinder or by electrically operated floor stands. In cases where the regular line will not fulfill the requirements, Mueller-Columbian can offer experienced engineers and the finest facilities to produce equipment to exact specification.



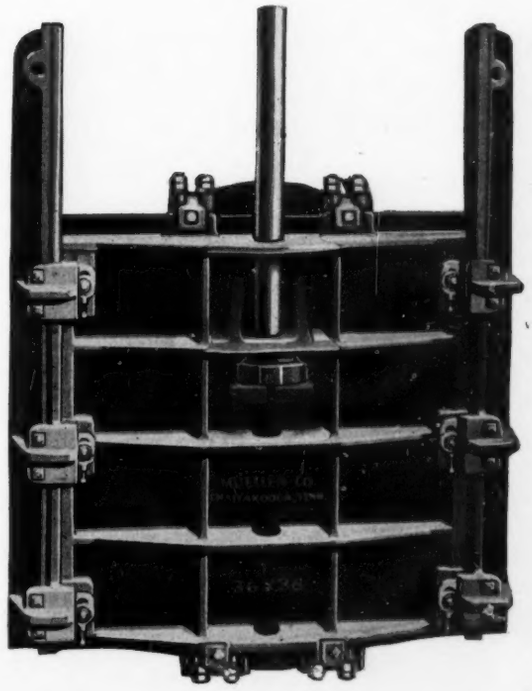
Get in touch with Mueller-Columbian before you specify. It may result in unusual savings. Recommendations, specifications, and estimates cheerfully given.

COMPLETE LINE

A complete line of water control equipment is manufactured by Mueller-Columbian including Sluice Gates, Floor Stands, Valves, Shear Gates, etc. Write for Catalog A-300 that shows the complete line as well as valuable engineering data.

FLOOR STANDS

The line of Mueller-Columbian Floor Stands is most complete. They may be had with either rising or non-rising stem in plain or ball bearing type and with geared, two speed operation. For remote control, hydraulic cylinders or electrically operated stands can be furnished to meet practically any requirement.



MUELLER COLUMBIAN

WATER CONTROL EQUIPMENT

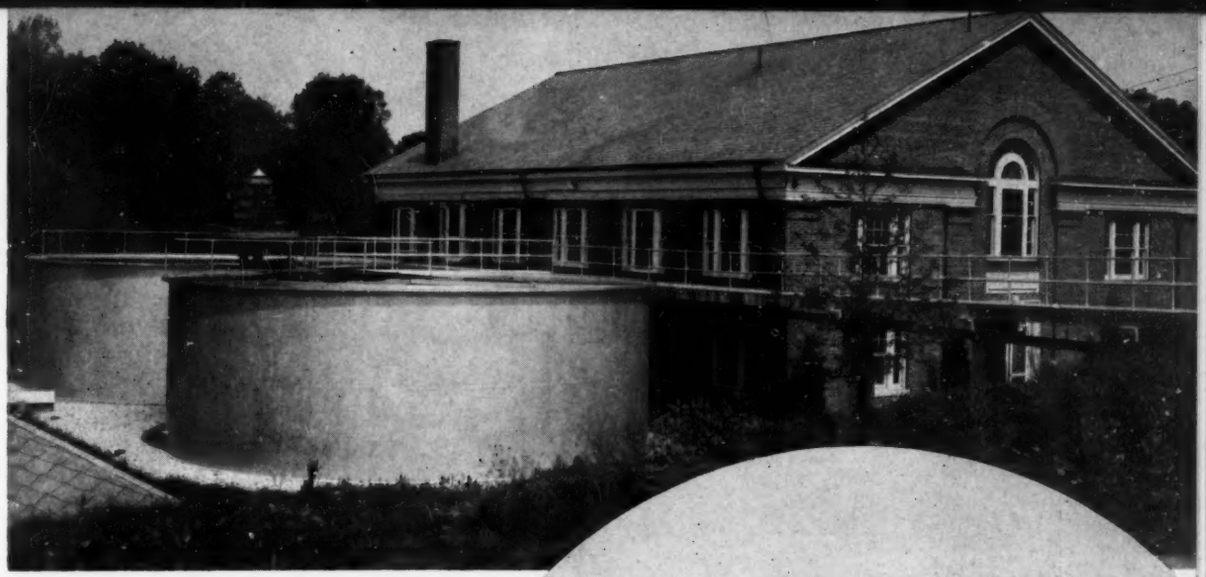
Recent air view of Barberton Plant, THE COLUMBIA ALKALI CORPORATION

USERS of COLUMBIA LIQUID CHLORINE enjoy the advantages of a uniform product of full strength produced in a modern plant, centrally located and served by four railroads. Distribution equipment is rigidly inspected before each shipment, insuring cleanliness and perfectly fitting valves. Lightweight pressed steel cylinders are used and all equipment conforms to the standards of the ICC and the recommendations of the Chlorine Institute.

Delivery of COLUMBIA LIQUID CHLORINE for water purification and sewerage disposal is usually made in multiple unit cars, each carrying 15 one ton containers, but is also available in 16 and 30 ton single unit cars. When small amounts are desired, COLUMBIA LIQUID CHLORINE is delivered in 150 and 100 lb. cylinders.

COLUMBIA LIGHT SODA ASH is another COLUMBIA product preferred by many chemists for water treatment for its purity, free flow and rapid solubility.

Let us send you a copy of our tabloid catalog, "Products of COLUMBIA."

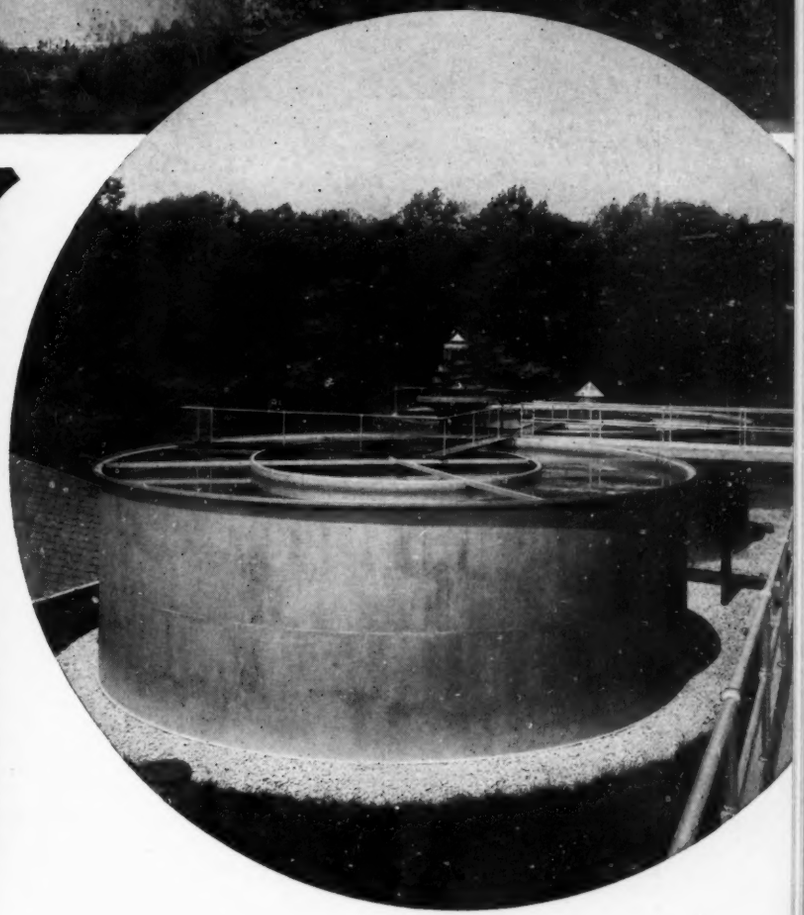


Uncle Sam is using

P·DM

SPIRAL SEDIMENTATION TANKS

FOR WAR DEPARTMENT SERVICE



When the U. S. Government installs water systems anywhere in its far-flung Federal domain, the equipment employed in assuring a safe and sanitary water supply must be of proven merit—built for the efficiency and honest long life that represent *true economy* in investment. These two steel sedimentation basins by P·DM exemplify the quality and performance built into all Pittsburgh-Des Moines water treating equipment. Of the high spiral baffle type, each unit is 36 feet in diameter by 12 feet high, providing a permanent, trouble-free installation.

P·DM All-Steel Sedimentation Tanks are guaranteed in design, material and workmanship—can be furnished in any required size—are low-priced, and built for life-time service. May we have your inquiries for this and all other types of modern water system equipment?

P·DM ALWAYS ON THE JOB

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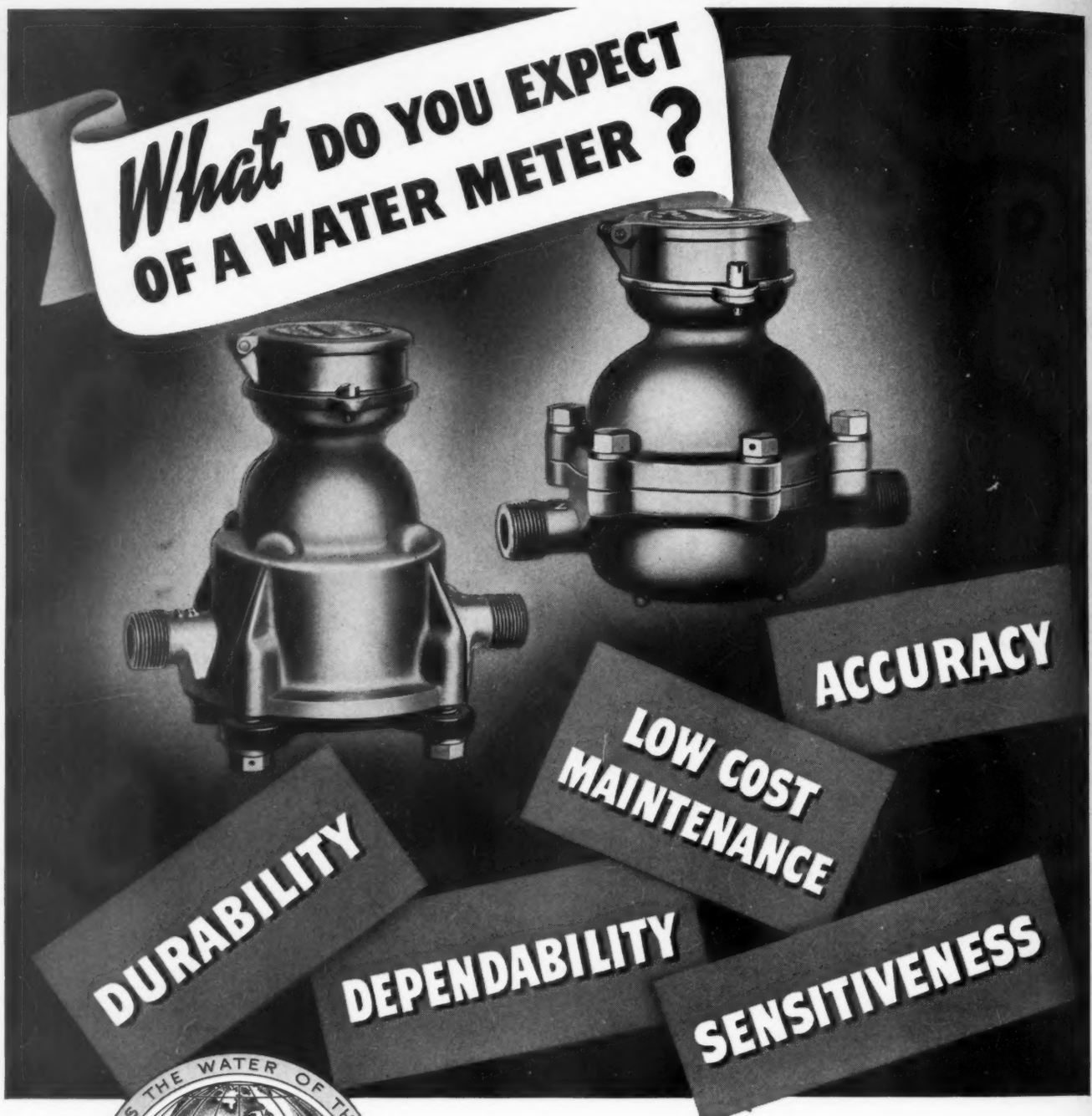

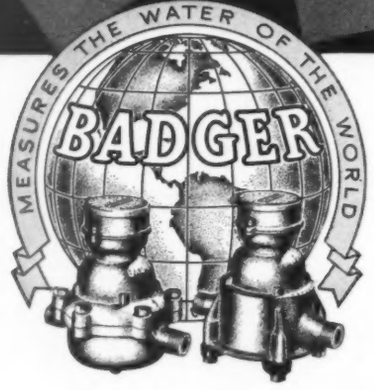

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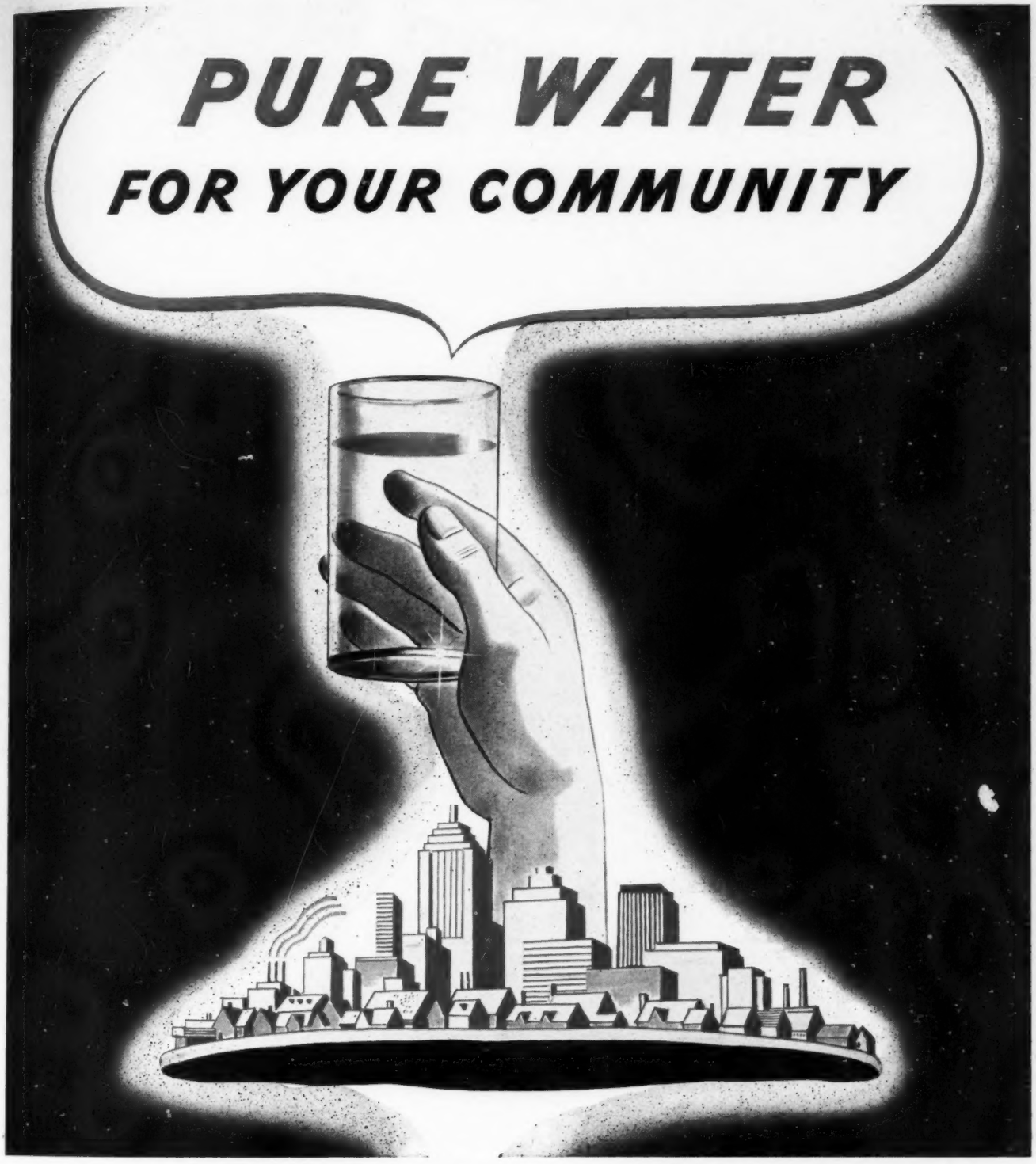
FOR YOUR COMMUNITY



Chlorination is the fifth and final link in the chain of modern water purification. After storage, sedimentation, coagulation and filtration, Diamond Liquid Chlorine is used and preferred by water works engineers from coast to coast, as the final safeguard to the purity of the community water under their direction.

Diamond Chlorine is delivered in pressure-proved cylinders of the latest type, ready for trouble-free attachment to your chlorinators. Quick, dependable service is always assured through the nation-wide network of Diamond Distributors, carrying warehouse stocks ready for immediate shipment as requirements demand.

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PLASTIC COLD TROWELING SEWER JOINT COMPOUNDS

SERVITITE—Cold Plastic Compound

The problem of root-clogged sewer pipes is eliminated by the use of Servitite. Servitite, used cold, does not shrink on hardening. Servitite sets under water. Servitite comes in units of 140 pounds, of which 100 pounds is in powder form and 40 pounds in liquid form.

Servitite is manufactured to provide an economical material always on hand for quick use on any sewer jointing job. Servitite is highly adhesive to clay or concrete pipe and hardens shortly after being installed. Servitite is flexible and acid-proof and more than anything—ROOT-PROOF—having incorporated in its composition an ingredient poisonous to vegetation. The special feature of Servitite is its being furnished in two units for mixing on the job as desired. Measuring containers are furnished with each order so that the contractor can prepare the desired amount of material to complete the job.

TUFFLEX

Cold troweling plastic for sewer pipe joints. Like Servitite, Tufflex is also a plastic cold troweling sewer compound. It is highly adhesive and produces an absolutely watertight connection. Tufflex is mixed at the factory and comes to the job ready for instant use without any additional preparation necessary. It is furnished in convenient size airtight drums. When only a portion of the drum is used the airtight cover is replaced to keep Tufflex in perfect condition for future use.

Sewers require repair when broken due to ground movement or trench settlement. Tufflex, being a highly flexible material, will take up this movement and at the same time assure watertightness due to its high degree of adhesion. This eliminates the possibility of foreign matter, root growths and infiltration of surface water. Tufflex also is made with a root deterrent and, being cohesive as well as adhesive, does not allow infiltration which is usually found in non-flexible sewer compounds.

Tufflex has been widely used for many years and is one of the most important pipe joint compounds on the market today. Cold troweling has many advantages over hot pouring or cement grout joints. Preheating time is saved as well as expense of runners and the additional labor saving for installation.

SERVICISED SELF-ADJUSTING EXPANSION JOINTS

for

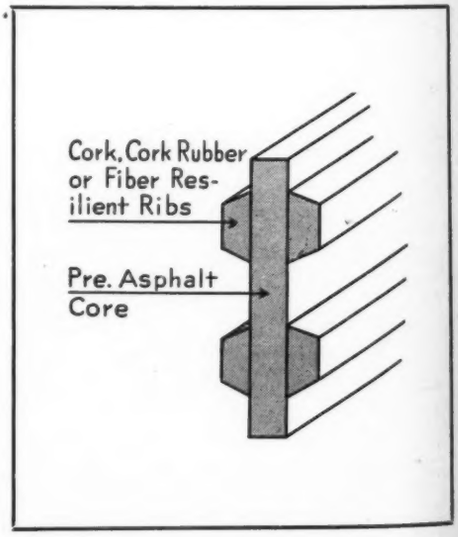
WATERPROOFNESS—NON-EXTRUSION

The Expansion Joint Problem for Sewage Disposal Plants has been a matter of serious concern. Extensive research along this line has resulted in the creation of a joint specially adapted for this purpose. The combined qualities of waterproofness and non-extrusion are of prime importance in work of this nature, and have made this joint an effective and practical unit.

As will be observed from the drawing, the Self-Adjusting Joint is simple in construction, yet its function is such as to solve completely the lack of waterproofness and non-extrusion so apparent in other joints. The filler core consisting of the standard type of premoulded Asphalt Joint has attached to it, resilient ribs as illustrated. The function briefly is that upon expansion of the concrete the displaced Asphalt Filler is extruded horizontally in the resilient ribs rather than upwards over the top of the joint. Upon contraction of the concrete the resilient ribs exert a back pressure against the asphalt filler readjusting it into place and at the same time maintaining a constant seal of protection against the seepage of water.

SHIELD

Years of research by the Servicised Laboratory along with collaborating tests made by various State Highway Departments bears out the efficiency of the Servicised Self-Adjusting type of Expansion Joint.



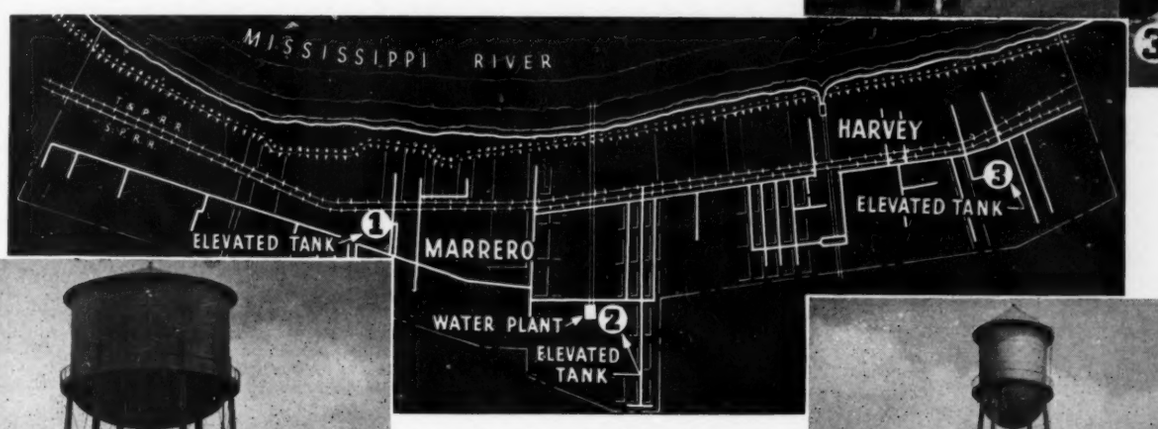
Write for Samples and Detailed Information.

THREE ELEVATED WATER TANKS

Provide Efficient "Distributed Storage"

AN excellent example of the way in which a "distributed storage" plan may be worked out is being demonstrated at the Jefferson Parish Waterworks District No. 2, which serves residential and industrial sections across the river from New Orleans, La. Three elevated tanks are used here, with a combined capacity of 500,000-gals., each located at strategic points within the four square miles which are served by the waterworks district. As illustrated in the condensed map shown below, adequate water storage facilities were needed to provide for an area much longer than it is wide. If only a single storage tank had been used, its effectiveness would have depended to a considerable degree on the size of the mains going out to the far ends of the district. As it is, with storage distributed in three tanks, no excessive burden is placed on any main. Important, too, is the increased availability of the reserve for fire protection—an especially valuable factor where there are many industrial plants, as in this particular waterworks district.

For further information about elevated storage tanks, please address our nearest office. There is no obligation on your part.



Directly above: Condensed map of the Jefferson Parish Waterworks District No. 2, which serves the district including Gretna, Harvey and Marrero, across the river from New Orleans, La. The location of the three elevated tanks is indicated, with corresponding numbers on each tank illustration.

Left: 300,000-gal. ellipsoidal-bottom water tank recently completed, which is located at the upper end of the waterworks system.

Right: 50,000-gal. hemispherical-bottom elevated tank, located at the main water plant, approximately in the center of the entire district.

Upper Right: 150,000-gal. ellipsoidal-bottom tank, located near the lower end of the waterworks district.

CHICAGO BRIDGE & IRON COMPANY

Chicago	2198 Old Colony Bldg.	Birmingham	1586 North 50th Street	Philadelphia	1644-1700 Walnut St. Bldg.
New York	3390-165 Broadway Bldg.	Tulsa	1646 Hunt Bldg.	Boston	1548 Consolidated Gas Bldg.
Cleveland	2262 Rockefeller Bldg.	Houston	2919 Main Street	San Francisco	1083 Rialto Bldg.
Dallas	1379 Liberty Bank Bldg.	Detroit	1551 Lafayette Bldg.	Los Angeles	1455 Wm. Fox Bldg.

Fabricating plants in CHICAGO, BIRMINGHAM, and GREENVILLE, PA.

CORROSIVE SOILS The asbestos-cement composition of J-M Transite Pipe provides exceptionally high resistance to soil corrosion. Where aggressive soils are encountered, Transite pays big dividends in reduced maintenance charges. Installation at left made in Nevada.

HANDLING COSTS Light in weight, Transite Pipe is supplied in long, 13-foot sections that are easily carried to the job in light trucks. Small crews—usually two or three men—can handle all loading and unloading operations without trouble. This job is part of a recent Transite installation in Ohio.

10 common water pipe problems—

DEEP TRENCHES The tough, asbestos-cement composition of J-M Transite Pipe provides great durability and uniform strength. When laid in deep trenches, such as this one encountered on a recently completed installation in Wisconsin, Transite Pipe is subjected to heavy earth loads and soil stresses . . . yet holds its true form under sustained pressure.

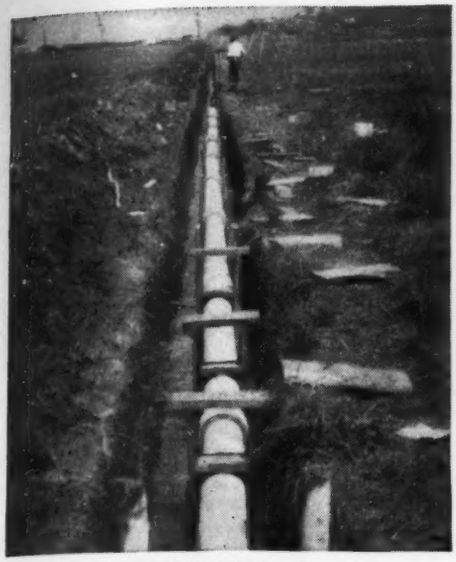
ELECTROLYSIS Transite's asbestos-cement structure is immune to electrolysis. It can be laid close to street-railway and power lines . . . gives continued freedom from repairs and replacements. This job is in Missouri.

AND TRANSITE

VIBRATION Flexible Simplex Couplings effectively absorb vibration caused by heavy traffic. On this bridge installation in Maine, these joints assure low maintenance, maximum protection against leakage.

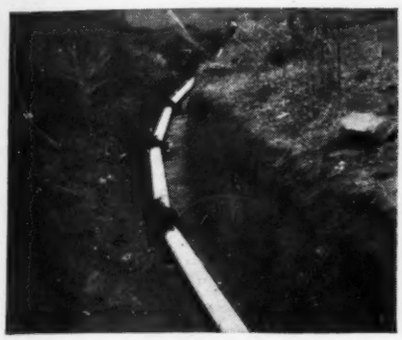
WHETHER you're up against one, two or all ten of the conditions pictured on these pages, you can still cut water-line costs. The pipe you use is the answer . . . and, by specifying J-M Transite, you get important advantages that make sizable savings on installation and maintenance costs, considerably reduce operating expense.

Transite Pipe is made of asbestos and cement. It is light in weight, comes in long lengths that make transportation and handling easy and economical. A simple assembly method permits unskilled crews to lay this modern water carrier rapidly, at low cost. And Transite saves still more in service. Being inorganic and nonmetallic, it offers unusual resistance to all forms of corrosion . . . combines great durability with uniform



WET TRENCHES Even in wet trenches such as on this Massachusetts job, Transite is installed quickly and easily. If necessary, Simplex Couplings can be assembled under water.

INSTALLATION COSTS The ease and speed with which Simplex Couplings are assembled sizably reduce installation costs. No skilled labor is needed. And, since the need for large bell holes at joints is eliminated, trenches are held to minimum widths. Above job in New York State.



WIDE SWEEPS Because of the flexible Simplex Couplings, wide sweeps can be made with straight lengths of Transite. As shown on this North Carolina line, no special fittings are required. And joints stay tight as long as the line is used.

JOINT LEAKAGE Simplex Couplings, consisting of a Transite sleeve and two durable rubber rings, keep joints tight indefinitely . . . assure maximum protection against costly water loss. The line shown above is part of a new Transite system in Arizona.

TUBERCULATION For lasting freedom from tuberculation, this Michigan municipality has installed a complete Transite system. Being non-metallic, Transite cannot tuberculate . . . its high flow coefficient (C-140) can never be reduced by this costly evil.

LICKS THEM ALL!

strength. Maintenance is minimized. And because it cannot tuberculate, Transite's smooth interior *maintains* its initial high flow coefficient of C=140 . . . keeps pumping costs permanently low.

Before you start your next water line, you'll find it well worth while to get all the facts on the 25-year service record of Transite Water Pipe. Send for brochure TR-11A. And, if you're interested in efficient, economical sewage disposal, you'll want full details on Transite Sewer Pipe . . . they are given in brochure TR-21A. Copies of both brochures are free. Simply write Johns-Manville, 22 East 40th Street, New York, N. Y.

THE MODERN MATERIAL FOR WATER AND SEWER LINES

JOHNS-MANVILLE JM PRODUCT

Johns-Manville TRANSITE PIPE

AN ASBESTOS PRODUCT

BECAUSE IT UNSCREWS

The Mathews Hydrant Cuts Accident Repair Costs

NO DIGGING

In case of traffic accident, you can change Mathews as you change a tire. The novel sliding protection case saves all the expense of breaking concrete and digging out your hydrant. You simply unscrew the broken barrel, lift it out through the protection case, and insert the new barrel—a single unit containing all working parts.

NO WASTE

Replacement is completed in fifteen minutes. Then, at a trifling cost, the broken barrel is repaired easily and conveniently in the shop, so that a single barrel, like a spare tire on a car, serves your entire hydrant system.

NO LOSS

Your department becomes more efficient when you specify Mathews interchangeable hydrants. They cut down long overtime—let you do much of your repair work indoors during regular hours. You save water leakage, too, for the main valve is *below* its seat, held tight by water pressure.

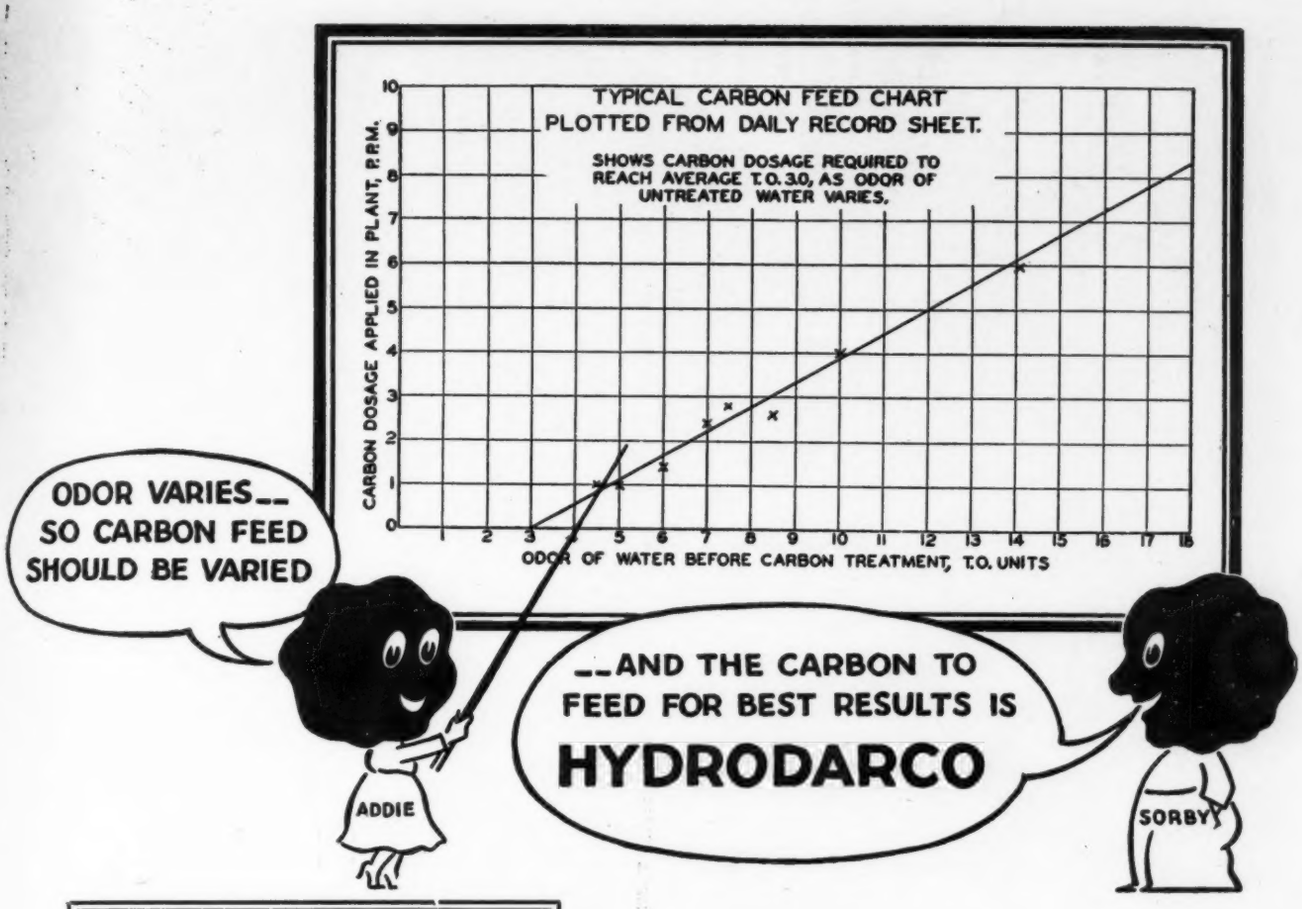
Safeguard your community's protection. Write for details about Mathews, the hydrant you change like a tire.

MATHEWS HYDRANTS

Made by R. D. WOOD COMPANY

Manufacturers of Sand Spun Pipe (centrifugally cast in sand molds) and R. D. Wood heavy-duty gate valves for water works

400 CHESTNUT STREET, PHILADELPHIA, PA.


TYPICAL CARBON FEED CHART
PLOTTED FROM DAILY RECORD SHEET.
SHOWS CARBON DOSAGE REQUIRED TO REACH AVERAGE T.O. 3.0, AS ODOR OF UNTREATED WATER VARIES.
CARBON DOSAGE APPLIED IN PLANT, P.P.M.
ODOR OF WATER BEFORE CARBON TREATMENT, T.O. UNITS
ODOR VARIES— SO CARBON FEED SHOULD BE VARIED
—AND THE CARBON TO FEED FOR BEST RESULTS IS
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Presenting

ADDIE and SORBY

. . . the "Ad-Sorption" twins, named after the word that means so much in removing tastes and odors. Addie and Sorby give valuable hints on the use of activated carbons.

THE CARBON FEED CHART shows plainly that the old idea of constant carbon dosage is wrong. Feeding too much carbon is wasteful. Feeding insufficient carbon is also wasteful because it leaves the water still unpalatable.

With the Carbon Feed Chart and the Darcograph, you know exactly how much carbon to feed—and *which* carbon to feed for most efficient removal of tastes and odors. Use these scientific, accurate methods to measure carbon performance right in your own plant! You'll see that HYDRODARCO* gives best palatability control per dollar!

The Carbon Feed Chart is practical and easy to use. It requires no special equipment. Start one today—and use HYDRODARCO, the activated carbon specially made for water treatment.

*Reg. U. S. Pat. Off.

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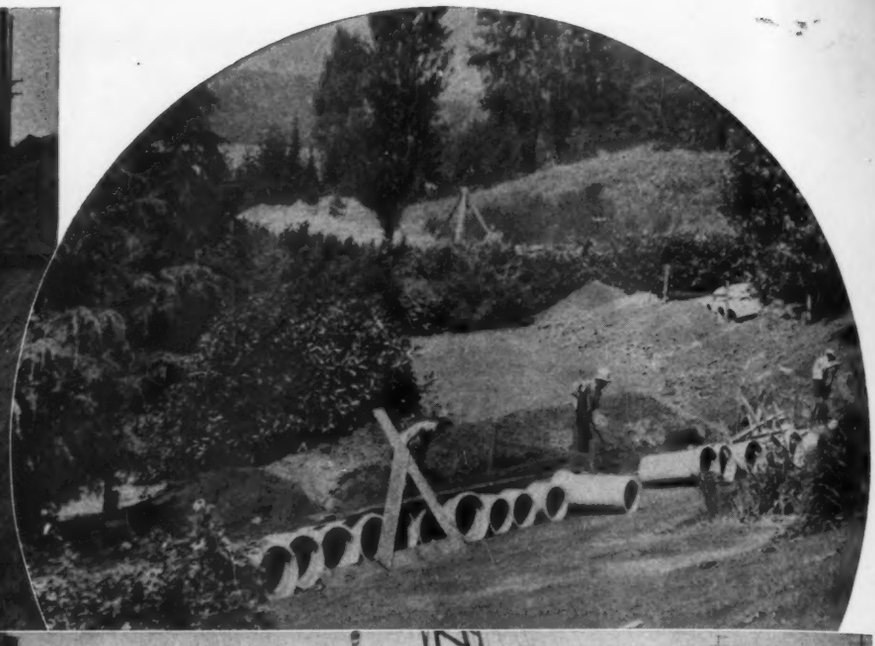


Construction scenes, Seattle sewer program. Seattle is one of many municipalities, large and small, which have capitalized on the strength, safety and durability of reinforced concrete and concrete pipe sewers. "Where Millions are at Stake, Sewers are Built of Concrete."

Seattle selects enduring CONCRETE for its $5,000,000 sewer projects

WITH 32 separate outfalls discharging into it, pollution of Seattle's beautiful Lake Washington became a serious danger. To solve the problem, a $5,000,000 network of trunk and intercepting sewers —*of concrete*—have been built or are now under construction.

A bond issue of $2,500,000 was voted in 1926. In 1928, $1,116,000 was used to build a 108-in. concrete sewer in tunnel discharging into Puget Sound. Construction was resumed in 1932 with an interceptor requiring 8,000 ft. of concrete pipe from 8 in. to 24 in. In 1934, with a PWA grant, interceptors costing $350,000 and using 18,945 ft. of 8-in. to 48-in. concrete pipe were constructed. A trunk sewer costing $700,000, requiring reinforced concrete pipe from 42 in. to 90 in. in diameter was partially constructed employing CWA and FERA labor. Later, a mile of 42-in. concrete pipe was placed with relief labor under WPA. A PWA project costing $230,000 and using 7,918 ft. of 8-in. to 72-in. concrete pipe was begun in January, 1935.

Three of the interceptors described above discharge into a 12-ft. concrete and brick sewer built in tunnel in 1910 which is in perfect condition today. To minimize leakage and infiltration, rigid tests of the completed sewer lines, including manholes, were required and met.

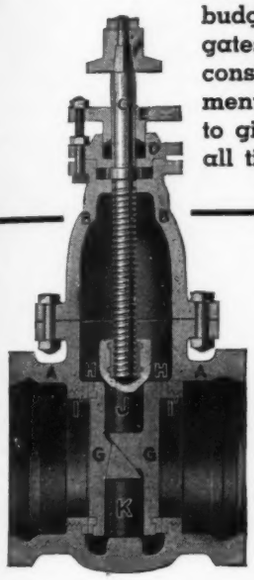
Concrete has demonstrated its adaptability, safety and economy in scores of important sewer projects. It is strong and durable; resists corrosion and requires little maintenance. Write for free literature covering all phases of sewer construction.

PORTLAND CEMENT ASSOCIATION
Dept. A9-29, 33 W. Grand Ave., Chicago, Ill.

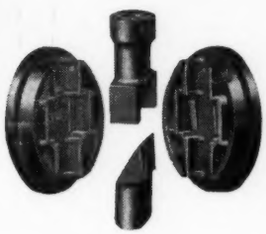
LUDLOW EQUIPMENT

fits into the FUTURE

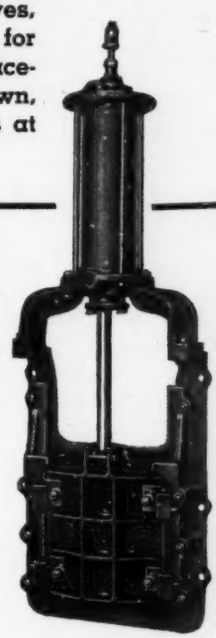
In the design and construction of all Ludlow waterworks and sewerage equipment our engineers have considered the needs of tomorrow as well as today. Whatever the years may bring—higher pressures, lower budgets, changing systems, or other unpredictables—Ludlow valves, gates, and hydrants can always be counted upon. Depend on them for constant service, low up-keep, resistance to wear and fewer replacements. And rely on Ludlow engineers to make your problems their own, to give you accurate estimates and make honest recommendations at all times. Write today for full information.



DOUBLE GATE VALVES — double disc, wedge closing, in 22 sizes. Steel, iron, and bronze mounted, 4" to 78"; bronze, ⅜" to 12"; extra heavy bronze, ½" to 2".



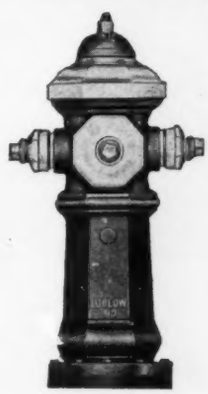
IMPROVED SLUICE GATE WITH HYDRAULIC CYLINDER — an advance in modern gate design, using adjustable top, bottom, and side wedges. Gates with circular or rectangular openings, rising or non-rising types, and various types of operating controls.



The Ludlow principle of valve construction — parallel seat, double wedge slide gate type — has been universally accepted and preferred for waterworks applications for nearly three-quarters of a century.

MUD VALVES — with bronze stems, seats and gate rings. Made with extension stem and wheel or in floor stand types. Sizes 4" to 24". Either rising or non-rising stem style.

SHEAR GATES — cast iron with bronze mountings. Spigot end type regularly stocked.



LUDLOW FIRE HYDRANTS — meet the most rigid specifications. Assure full flow, easy servicing, replacement without digging. No danger of freezing or breaking off below ground line.

FLAP VALVES—in all-iron, or iron body with bronze mountings. Sizes 3" to 48". Flange, spigot, or bell ends.

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Kansas City
R. A. Long Bldg.

Boston
73 Tremont St.

The LUDLOW VALVE MFG·CO· TROY·N·Y· SINCE 1866

Pittsburgh
Oliver Bldg.

Philadelphia
Harrison Bldg.

Chicago
7 So. Dearborn

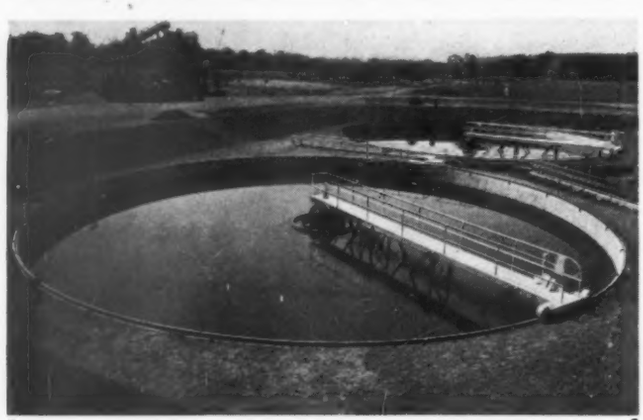
Houston
2615 Fannin

32 Final Settling Tanks equipped with STRAIGHTLINE Collectors, Ward's Island Sewage Treatment Plant, New York City. Fuller & McClinlock, Consulting Engineers.

STRAIGHTLINE COLLECTORS PROVE OUTSTANDING ECONOMY AND RELIABILITY

STRAIGHTLINE operation is of proved reliability. Link-Belt units have been in operation for over a decade and many installations are now in service in all parts of the country. They range in size from the smaller type plant as at Tappahannock, Va., with a capacity of 80,000 G.P.D., to larger installations such as Ward's Island, N. Y., with a capacity of 180,000,000 G.P.D., and Southwest Plant, Sanitary District of Chicago with a maximum capacity of 600,000,000 G.P.D.

Many features of the Link-Belt STRAIGHTLINE Collector are patented. Send for Book No. 1742.



City of Dayton, Ohio, 4 final tanks equipped with CIRCULINE Collectors. M. D. Tatlock, Consulting Engineer and Superintendent.

CIRCULINE COLLECTOR WITH STRAIGHTLINE EFFICIENCY

The Link-Belt CIRCULINE Collector provides round tanks with the same important features which have made the STRAIGHTLINE Collector the acknowledged standard for rectangular tanks.

A CIRCULINE equipped tank is provided with a revolving bridge carrying a sludge plow and a STRAIGHTLINE conveyor which positively delivers the settled solids into an annular covered sludge trough from which they are withdrawn. The entire floor of the tank is cleaned of settled solids during each revolution of the bridge, thereby permitting extremely slow movement of the bridge and conveyor, which assures minimum disturbance of settling and of the settled solids. Send for Book No. 1642.

Link-Belt Horizontal Mixer at the Danville, Ill., chemical treatment plant. Greeley & Hansen, Consulting Engineers.

EFFICIENT FLOCCULATION

Link-Belt mixers of the vertical or horizontal type have proved their value in reducing chemical costs and promoting efficient flocculation.

Link-Belt STRAIGHTLINE Mechanically Cleaned Bar Screens at Sewage Pumping Station, Lackawanna, N. Y. Nussbaumer & Clark, Inc., Consulting Engineers.

A BAR SCREEN THAT CANNOT JAM

The STRAIGHTLINE Mechanically-Cleaned Bar Screen is the modern method of removing large suspended solids and debris from incoming sewage at both large and small plants.

All of our experience with sewage screening work, since the installation of the first Link-Belt mechanical screen in 1915, is built into the design of this unit. Its rugged, simple construction and special provisions for the avoidance of jamming assure dependable, uninterrupted operation under the most extreme conditions of service. Send for Book No. 1587.

LINK-BELT COMPANY 7944

Philadelphia Chicago Los Angeles Indianapolis
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LINK-BELT
SEWAGE TREATMENT AND WATER PURIFICATION PLANT
EQUIPMENT

MATHIESON

GIVES VALUED SERVICE TO MUNICIPAL WATERWORKS

Earl Mitchell, Superintendent of Filtration, Paducah Waterworks, Paducah, Kentucky—watching a cylinder of Mathieson Chlorine at work in the Paducah Chlorine Room.

Says Mr. Mitchell:

"We have used Mathieson Chlorine for the past eight years and Mathieson Ammonia and HTH for the past three years.

"During that time, we have been well pleased with your products, both from the standpoint of service and the condition of the cylinders on arrival. We have never received any dirty cylinders of chlorine or cylinders with sticky control valves.

"We use chlorine both for pre-chlorination and post-chlorination, and ammonia to help maintain the chlorine residual at all points in the distribution system. We use HTH in sterilizing new mains and in sterilizing filter beds, with perfect satisfaction."

Paducah's experience with Mathieson waterworks-sanitation products is typical of that of many cities throughout the length and breadth of the United States.

Mathieson Chlorine and Mathieson Ammonia have proved, through years of satisfactory service, their thorough purity and dependability. And not least important, from a practical point of view, is the fine service record of Mathieson's safe, trouble-free cylinders and valves.

Mathieson HTH—a dry, free-flowing chlorine carrier containing 70% available chlorine—has an equally impressive record. Many cities keep a supply of Mathieson HTH constantly on hand not only for such everyday jobs as sterilizing new or newly-repaired mains, but for many special and emergency jobs where a mobile, high test chlorine carrier is required.

HTH comes in 5-lb. cans with replaceable caps, packed 9 cans to the case; also in 75-lb. drums.

THE Mathieson Alkali Works (INC)

60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . BICARBONATE OF SODA . . . AMMONIA, ANHYDROUS and AQUA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . LIQUID CARBON DIOXIDE

Jeffrey JIGRIT

Descriptive of the Method

BEST BY TEST

Efficient grit washing equipment designed for relatively small plants is now available in the Jeffrey JIGRIT No. 1, an inexpensive machine based upon established operating principles. It is power operated, but manually controlled.

A series of tests conducted recently in the plant of a large eastern city proved the Jeffrey JIGRIT *best by test.*

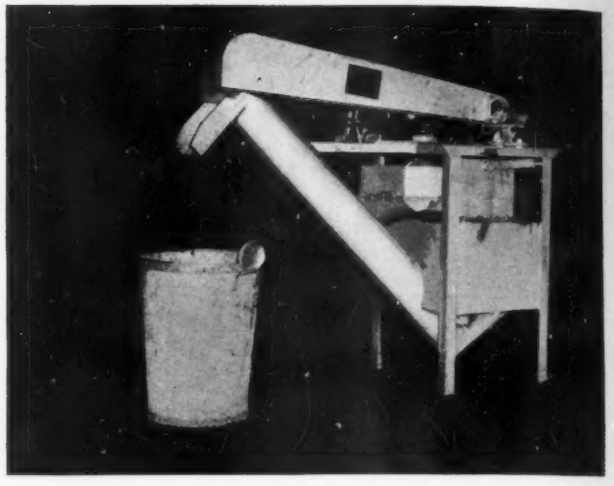
The JIGRIT feed averaged 4.5% putrescible solids and the washed grit product averaged only .40% putrescible solids, a reduction of 91%. The organic overflow contained only a negligible amount of grit as found from ash determinations.

The Jeffrey JIGRIT method of washing grit has been in use more than two years.

Send for descriptive literature

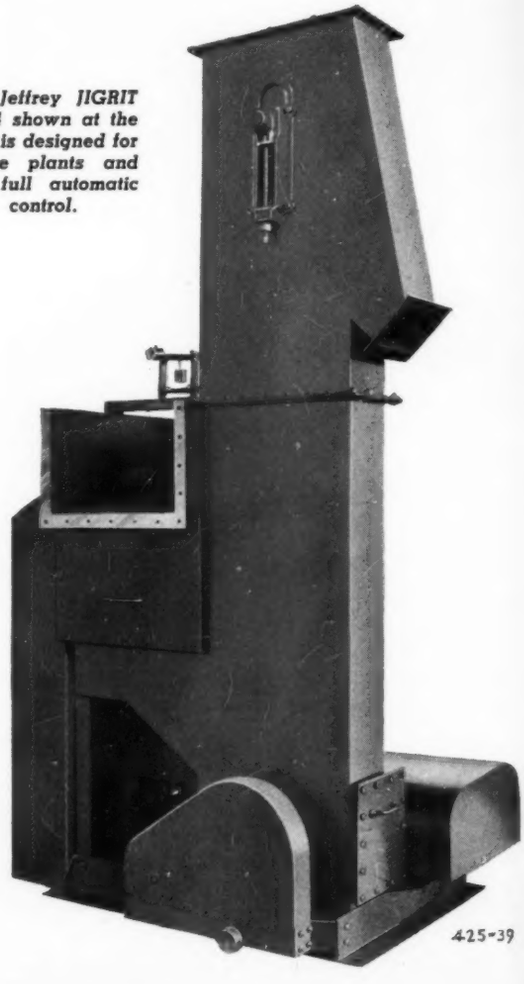
The Jeffrey Mfg. Co.

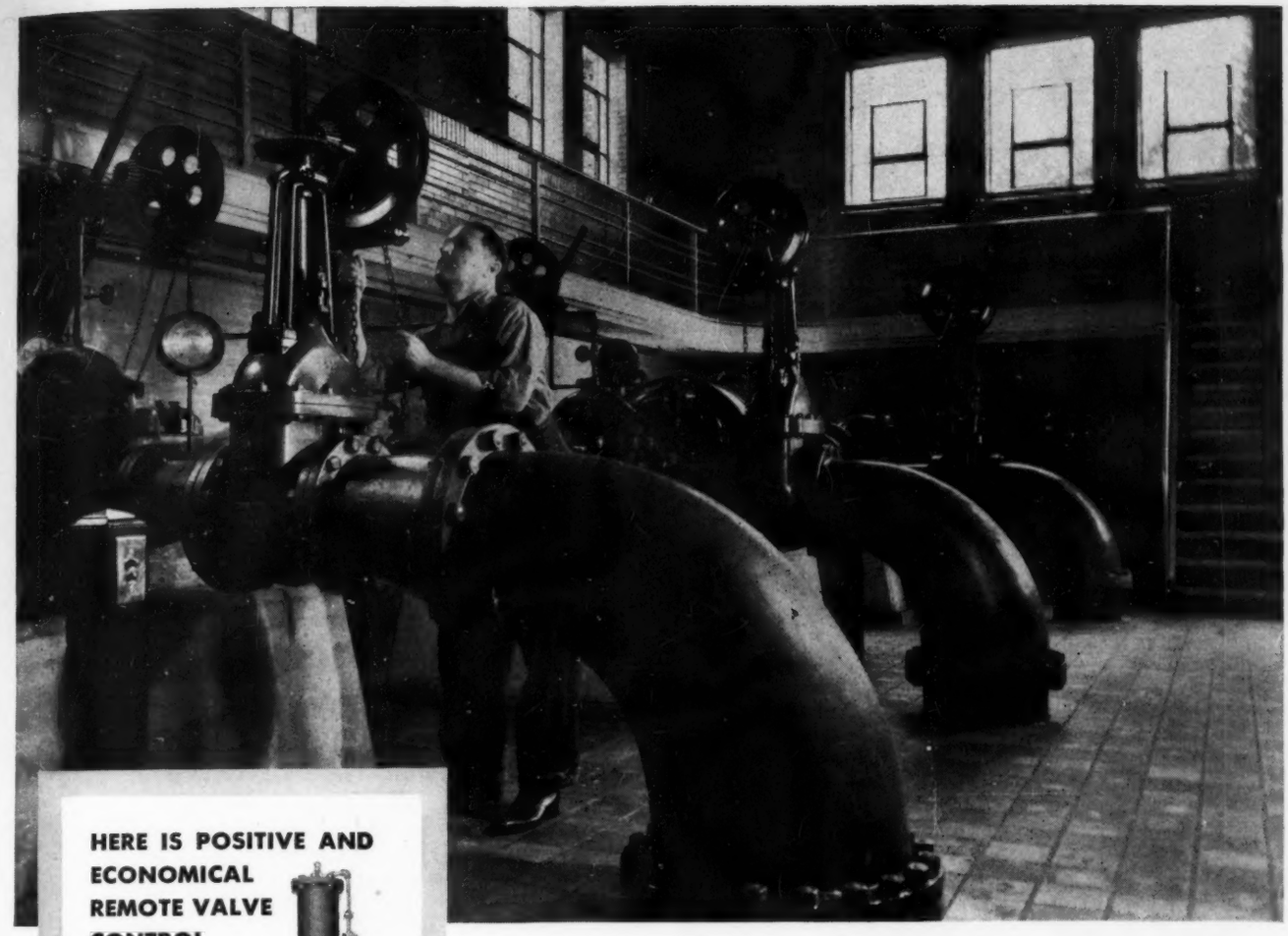
996-99 North Fourth Street, Columbus, O.



This small unit No. 1 is installed to operate in conjunction with V-Bucket type grit collector mechanism introduced by Jeffrey many years ago.

The Jeffrey JIGRIT No. 4 shown at the right is designed for large plants and has full automatic control.





HERE IS POSITIVE AND ECONOMICAL REMOTE VALVE CONTROL

Cylinder operation is the logical choice for faithful response to central panel control. Why? Because cylinder mechanism is not dependent upon power supply which may be interrupted at an urgent moment. What's more, with hydraulic power readily available at the point of valve installation, its economical advantage is important.

The simple yet sturdy construction of Crane-perfected cylinder mechanism is most desirable for water works, filtration plants and sewage systems. Unexcelled in trustworthy performance, it is easily installed, easily maintained at constant efficiency.

Your Crane Representative can give you interesting facts about Crane valve-operating mechanisms of every practical type.

PRIDE OF THE VILLAGE

...Its Crane-Equipped Water Works

IN a village of beautiful homes and gardens on the shores of Lake Michigan, this water works provides adequate comfort for 15,000 people. Village-owned, with a capacity of 6 million gallons daily, it is a model plant of modern efficiency—the pride of the village!

The satisfaction of this community with its water works is matched by satisfaction with the Crane valves that control the flow of water at every stage of pumping and filtering.

Good performance, as well as the safety of your investment in valves lies principally in the proper selection of equipment for the job to be done. Crane, offering a complete line of soundly engineered valves, can assure dependable flow control at minimum cost—in every valve application. Whether you operate a water or sewage treatment plant—whether you need a big sluice gate or a small valve for a residential shut-off line, Crane can supply a valve that is designed to give you complete satisfaction in the service.

In the Crane No. 52 Catalog, there are listed more than 38,000 items that meet every flow-control requirement. Gain for yourself, and the people you serve, the distinctive advantages that Crane-Equipment brings to any piping system. Your Crane Representative is at your service.

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VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

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Read them and you'll understand the sincerity with which A.B.P. publications are constantly striving to improve their worth to readers . . . their value as advertising media.

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The publisher of a business paper should dedicate his best efforts to the cause of business and social service, and to this end each member of The Associated Business Papers, Inc. pledges himself:

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¶ 5 To make available to advertisers full information regarding character and extent of circulation, including detailed circulation statements, subject to proper and authentic verification; and to maintain effective control over circulation sales channels to the end that (a) subscriptions will be solicited only from individuals and firms interested in the field or industry served by the publication; (b) any premiums offered will not be introduced into any sales combination to the extent that the paper is bought mainly to secure the premium; (c) the amount of commission paid salesmen shall not be so great as to encourage price-cutting to obtain a subscription order.

WATER WORKS AND SEWERAGE

Member of The Associated Business Papers • Inc.

SAVE ON SEWERS

THESE money-saving features of J-M Transite Pipe offer important ways of cutting costs and increasing efficiency on all types of sewer-line systems. The light weight, long lengths and simple assembly of this modern pipe considerably reduce laying costs. Maintenance is negligible because Transite, made of asbestos and cement, is exceptionally corrosion-resistant, uniformly strong. And, in many cases, its high flow coefficient and tight joints permit the use of smaller pipe or flatter grades.

If you are planning a new system or modernizing an existing line, you will profit by getting full details on J-M Transite Sewer Pipe. Write for brochure TR-21A. And, for information on J-M Transite Water Pipe, write for brochure TR-11A. Johns-Manville, 22 East 40th Street, New York, N. Y.

FREE Book Gives Convincing Facts— Write for Your Copy

Johns-Manville TRANSITE PIPE

THE MODERN MATERIAL FOR SEWER AND WATER LINES

LEADITE

Trade Mark Registered U.S. Pat. Office

The Pioneer Self-Caulking Jointing Material for Bell and Spigot Water Pipe

Products

LEADITE and the following tools and equipment for use with LEADITE:

BRAIDED JUTE, JOINT RUNNERS, GASOLINE and WOOD BURNING MELTING FURNACES, POURING LADLES, POURING POTS, YARNING IRONS and METAL POURING GATES.

Description

Leadite is principally used for making joints in cast iron bell and spigot water mains; is shipped in powder form in sacks containing 100 pounds.

Users

Water works superintendents, engineers, contractors, mines, railroads and industrial plants all over the world use Leadite. Thousands of miles of pipe jointed with Leadite are in service.

Method of Use

The joint space is first "yarned" and the Leadite is melted and poured into the joint, but requires no caulking. Leadite melts at approximately 250° F. Lead melts at approximately 620° F.

Comparative Quantities

One hundred pounds of Leadite are equivalent to approximately four hundred pounds of pig lead based on the joints being made the same depth with either material. It will be easy to figure the approximate quantity of Leadite required for any given quantity of pipe by referring to our Reference Table, copy of which we shall gladly send to you upon request.

Comparative Cost

Under normal conditions, the economies effected by the use of Leadite save approximately 50% to 75% over the method which requires caulking, owing to the saving effected in material and labor.

Saving

Because Leadite saves on the items of caulking charges, digging of large bell-holes and reduces cost of trench pumping to a minimum, Leadite eliminates most every superfluous operation in jointing cast iron water mains, thus permitting the work to be completed with the least amount of effort.

Tools

As no caulking is required, fewer tools are needed.

No Caulking

Leadite joints require no caulking because Leadite adheres to the pipe from the yarn or jute out to face of bell, making a watertight bond. However, a Leadite joint may be melted or cut out at any time if desired in making connections, etc.

Durability

Leadite has been tested and used for more than 35 years and experience has proven that Leadite joints improve with age.

Expansion and Vibration

Leadite is used with excellent results under railroad tracks, highways and over and under bridges where severe vibration has demonstrated the value of using Leadite on this class of work.

Utility

Leadite is very easy to handle. It is used on all sizes of pipe from four to eighty-four inches in diameter and under all conditions and pressures encountered in water works construction.

Electrolysis

Leadite resists electrolysis.

Damage Suits

Claims for damages caused by joints blowing out are reduced because Leadite joints, if properly made, will not blow out under any pressure common in water works construction.

Transportation

Considerable freight charges are saved because Leadite is light in weight. This also means a saving in cartage and handling on the work because you move approximately one-fourth the weight of jointing material.

Delivery

We make prompt shipments of Leadite in any quantities from stock.

Fuel

Saves fuel because you melt approximately one pound of material instead of four, and less heat is required to melt Leadite than is needed to melt lead.

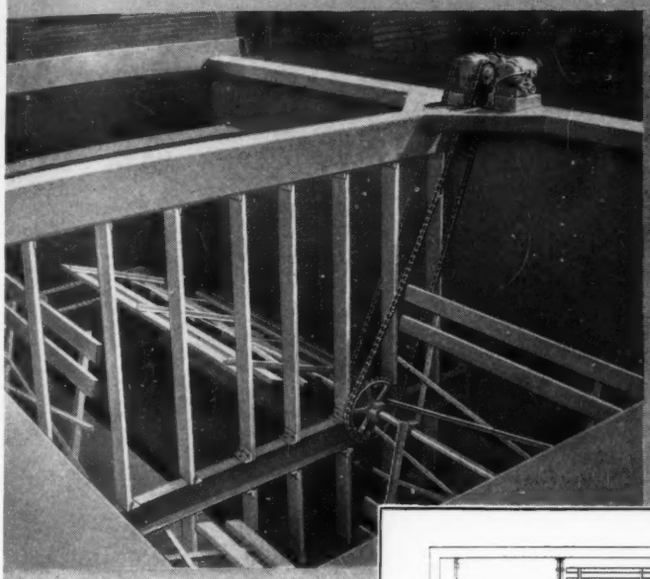
Be sure it is Leadite and not something "Just as Good"

THE LEADITE COMPANY

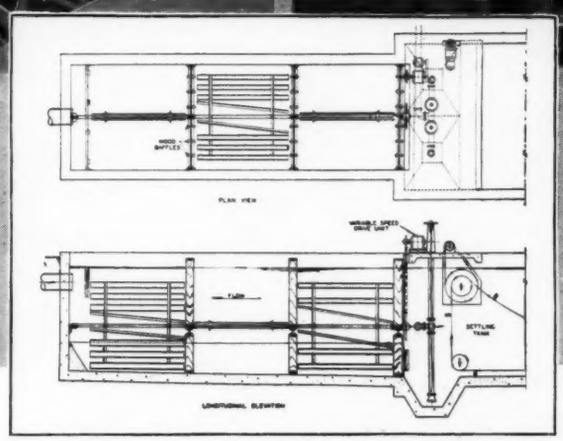
Girard Trust Company Bldg., Philadelphia, Pa.

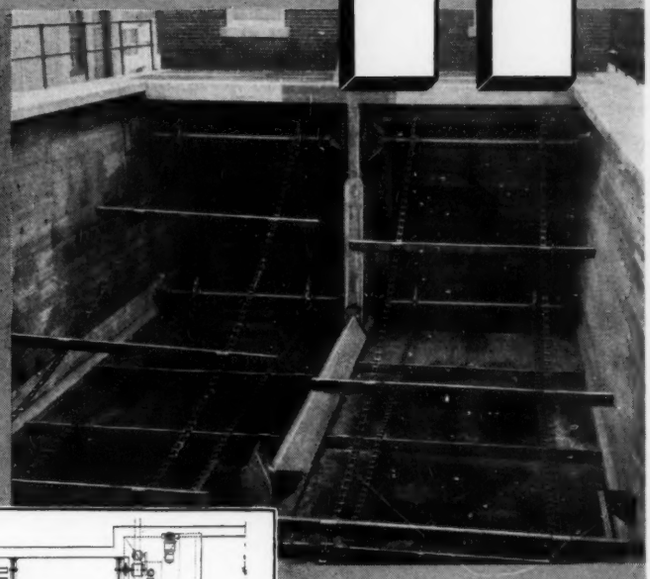
No Caulking

FOR FLOCCULATION *and* SEDIMENTATION
HERE'S HOW TO HANDLE IT



You'll find many improvements over ordinary types of flocculating equipment in the new Rex Slo-Mixer—one of which is shown above, installed in the new plant in Ottawa, Illinois. The line drawing at the right illustrates the Slo-Mixer's efficient method for progressive reduction of turbulence.





The Rex Conveyor Sludge Collector shown above is installed at Waupun, Wisconsin—one of numerous plants using the Rex chain and scraper way of removing sludge and silt from settling basins in sewage and water treatment tanks.

REX SLO-MIXERS..REX CONVEYOR SLUDGE COLLECTORS

Rex Slo-Mixers are designed and built to produce flocculation efficiently and at lowest cost for chemicals in the treatment of sewage or water. In the Rex Slo-Mixer process, the moderate turbulence of the liquid is *progressively decreased* (a patented process) to promote and maintain optimum flocculation. The mixers or agitators operate parallel to the flow. Proper baffles minimize short circuiting. Longer, actual detention periods are obtained and thus there is greater flocculating efficiency. The simplicity of the Rex design enables single or multiple units to be applied with assured satisfaction to any sewage or water treatment plan.

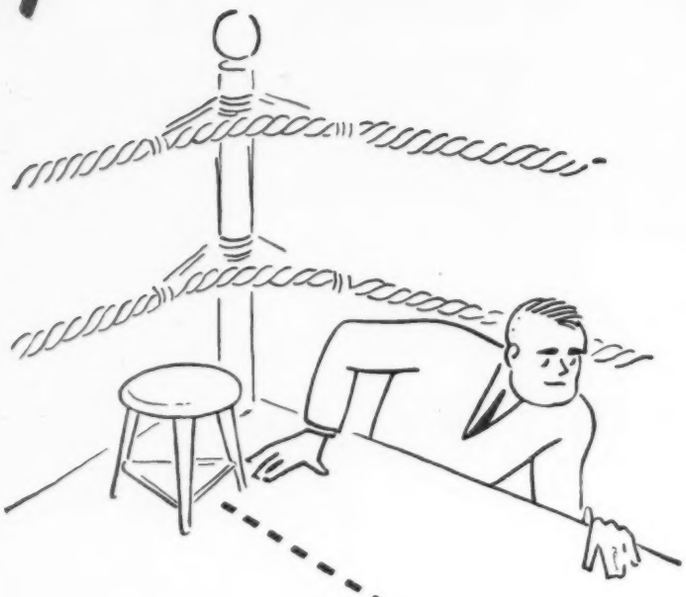
Rex Conveyor Sludge Collectors offer municipalities and industrial plants a proved, efficient and reliable means of removing flocculated solids. The Rex rectangular tank design simplifies the combination of Rex Slo-Mixers and sedimentation units in designing any plant. The Rex line of Sanitation Equipment also includes other modern, highly efficient equipment, including Rex Traveling Water Screens, Rex Tow-Bro Sludge Removers, Rex Triturators (screening shredders), Rex Grit Collectors and Rex Bar Screens. Catalogs on any or all of this equipment are available. Send for copies on those items in which you are interested.

Address the Chain Belt Company, 1610 W. Bruce Street, Milwaukee, Wisconsin.

REX SANITATION EQUIPMENT

CHAIN BELT COMPANY of Milwaukee

Your Seat-a Ringside Seat!



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YOU WON'T WANT TO MISS

IDENTICAL INTEREST LUNCHEONS
TRADE SHOWS—EXHIBITS—AWARDS
PUBLISHERS' RECEPTION—DINNER—SHOW
N.I.A.A. DAY AT THE WORLD'S FAIR

•

NEW LOW TRANSPORTATION COSTS
THIS YEAR

NO INCREASE IN RATES AT THE HOTEL NEW YORKER

•

GET YOUR RESERVATIONS IN EARLY THIS YEAR

National Industrial Advertisers Association
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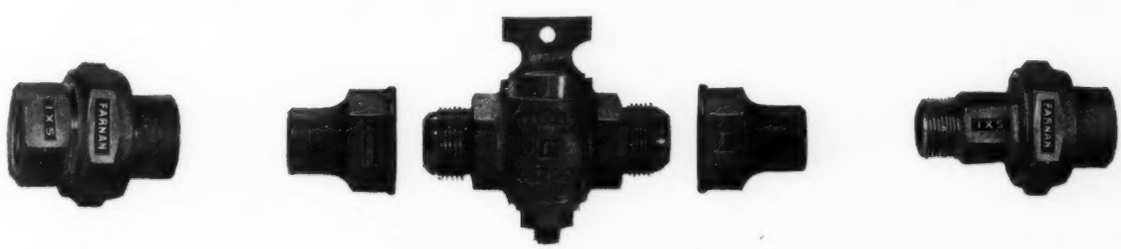
NEW ENGLAND . . EAST - WEST - MIDDLE WEST - AND SOUTH

Brass Service Material for All Requirements Is Furnished by . . .

FARNAN

FARNAN brass goods are most reasonable in priee . . . certainly worth more than products of unknown merit.



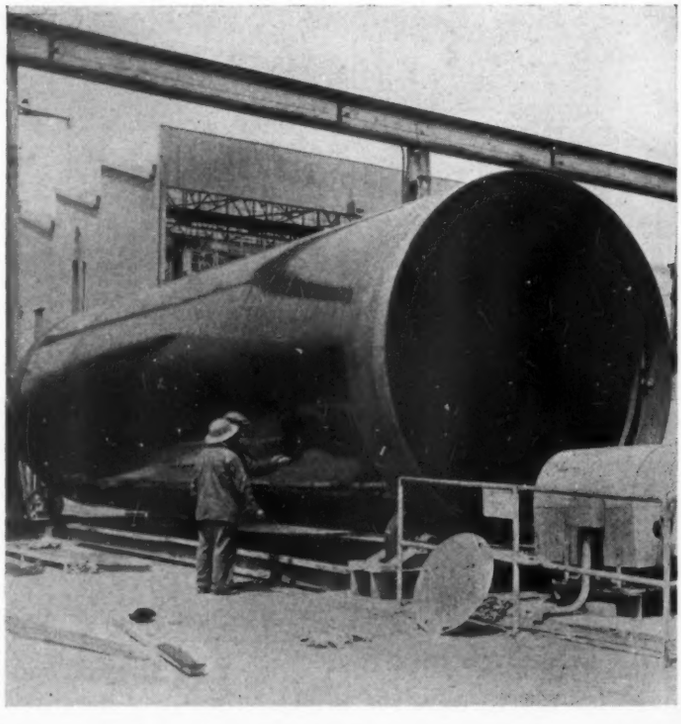
QUOTATIONS ON YOUR REQUIREMENTS GLADLY SUBMITTED

THE BEST OBTAINABLE AT ANY PRICE

THE FARNAN BRASS WORKS CO.

CLEVELAND EST. 1852 OHIO

DEPENDABLE PROTECTION INSIDE AND OUTSIDE WITH Reilly PRIMER and PIPE ENAMEL...



● Reilly pipe coatings have *proved* their dependability in all sections of the country and under the most difficult conditions of service. Properly applied, these coatings offer permanent protection to all exposed surfaces against rust and corrosion and effectually prevent loss of flow, due to tuberculation of pipe interiors. Highly resistant to abrasion. Will not sag at high temperatures, nor chip or peel when subjected to sub-zero cold. Complete information furnished upon request.

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Executive Offices: Merchants Bank Building, Indianapolis, Indiana

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WATER WORKS & SEWERAGE

Published Monthly by Gillette Publishing Company

PUBLICATION OFFICE
330 South Wells Street Chicago, Ill.
E. S. Gillette, Publisher

EDITORIAL OFFICE
155 East 44th Street New York, N. Y.
L. H. Enslow, Editor

COMING!

Articles

"Recarbonation by Submerged Combustion"
Is the story of a "flame that never fails". For some time the heating and evaporation of liquids has been successfully accomplished by under-water gas burning. This scheme has now been successfully applied in the recarbonation of lime softened water at Oklahoma City. Strange sight to look down through 10 or more feet of water at blue gas jets uninterruptedly burning—that's the thrilling part. The practical aspect is the simplicity of the scheme of producing carbon-dioxide at the spot of absorption thus reducing equipment and maintenance to a minimum, along with costs.

"Sludge Filtration"
Four installments of a series of five articles by L. W. VanKleeck on this important topic in modern sewage and industrial waste disposal have already appeared in this magazine. The concluding article discusses the question —"To digest, or not to digest", sludge in conjunction with vacuum filtration. It then discusses vacuum filters with respect to desirable features and improvements deserving consideration in future design, based on operating and maintenance experiences.

"Centrifugal Pump Testing"
Is a discussion of the things that most commonly cause low efficiency and high cost of pumping. Second, things to consider in the selection of a centrifugal pump for the job. Third, a presentation of a simplified and practical method of routine checking of centrifugal pumps for efficiency.

"The True Value of Sewage Sludge"
Is to comprise a discussion of the merits and value of digested sludge for its **"fertility** values" as a distinctive attribute, rather than its **"fertilizing** value". There is an important distinction between these two values. In the first, lies the real value of sludge which the yardstick of the fertilizer analyst does not reveal. Dr. Rudolfs has earlier given hints of the important role of what may be termed the "catalytic" nature of certain growth promoting substances in sludges (hormones and the like), and his article will emphasize this attribute in terms of "fertility values".

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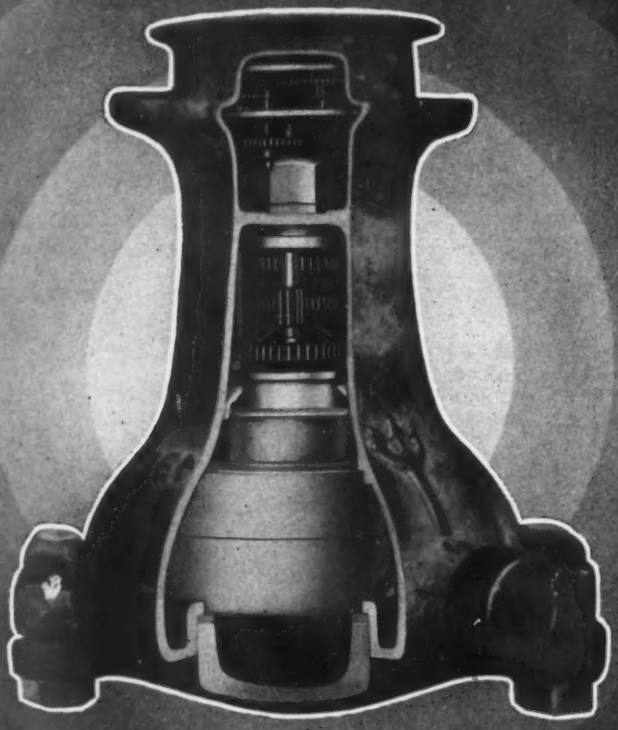


MODERN INTERCHANGEABLE PARTS
IN AN 1899 TRIDENT WATER METER

"CASH REGISTERS OF THE WATER WORKS FIELD"

YESTERDAY
TODAY
TOMORROW

THE SYMBOL OF SUSTAINED ACCURACY

THE TRIDENT METER

is not a static mechanism. The disc principle is basic, and remains unchanged, as does also the principle of interchangeability. But through the years, the meter itself has been constantly subject to refinements . . . and these refinements can be incorporated, through interchangeable parts, in Tridents that have seen 20—30 or even 40 years of service, making them actually better than when they were new, eliminating obsolescence, protecting capital investment, minimizing maintenance.

MORE THAN 5½ MILLION SOLD—THE GREAT MAJORITY STILL SERVING

WATER WORKS & SEWERAGE

VOL. 86, NO. 9 *A Gillette Publication* SEPTEMBER, 1939

ON WATCHING YOUR CASH REGISTER

An Evaluation of the Economic Limits of Meter Maintenance

(Part I)

By D. R. TAYLOR
Plant Supt., Water Department
ROANOKE, VIRGINIA

REGARDING meter maintenance, many splendid articles have been written and papers read by unusually capable water works men. The value of meter maintenance to the water utility, and the fairness or equity to the consumer has been well covered and thoroughly expounded.

We would like to discuss this important component part of efficient water plant operation from an angle that we believe to be the most important of all—namely, one in which apparently the least amount of progress has been made toward a satisfactory solution.

Considering the great volume of information that has been released, it is surprising how little attention a great number of cities and towns have devoted to meter maintenance. It is equally as interesting to observe the rather extreme limits to which a few cities and towns go in the matter of meter maintenance.

The Author

A great many feel even in this day that, if a meter is running, it is giving satisfactory service and that it needs no attention until it is reported by the meter reader or billing clerk to have dropped in registration very materially or to have completely stopped. In this particular case such an attitude of "out of sight, out of mind," or "don't trouble trouble until trouble troubles you" would seem to be a somewhat costly attitude.

More Balance Needed

Surely there must be some line of demarcation between the practice of spending little or nothing on meter repairs, on the one hand, and spending more than is gained in additional revenue, thereby, on the other hand.

Some orators have earnestly warned you that many of your available dollars have been rolling away as a result of an unbelievable amount of your consumption

Here is the opening installment of an article that differs in a rather interesting degree from the usual article dealing with maintenance of water meters.

The caption and sub-caption are in themselves explanatory. Mr. Taylor therein puts first emphasis on the need for "Watching Your Cash Register"—namely, the meters of the water utility. In his sub-caption, however, he sounds the cautioning note that there is an economic limit to the degree of watching—meaning that maintenance costs may readily reach a point above that at which the line of increase in accounted for water (income gains) and the line of maintenance costs approach or cross each other.

In Mr. Taylor's contribution, which will require three issues for completion, the author reports on a study undertaken to determine facts upon which the limits of routine meter maintenance practice might be determined from the standpoint of maximum return for the dollar expended.

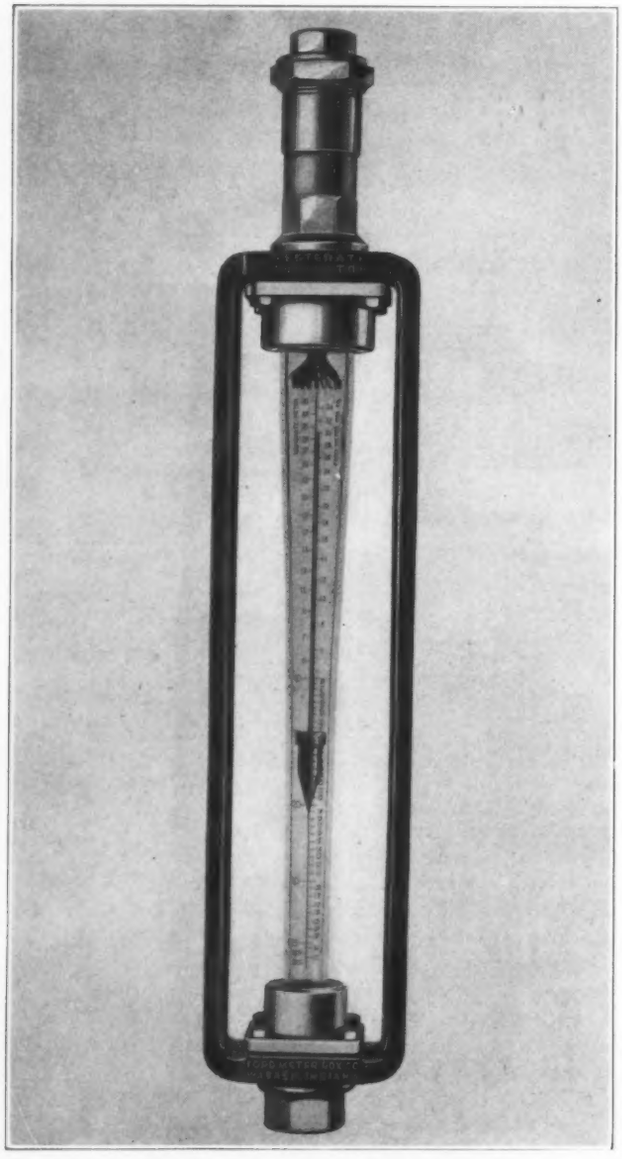
Whether the exact plan evolved for the Roanoke Water Department will, or will not, apply in other cities is not of chief moment. The important considerations are the basic principles involved and questions raised by Mr. Taylor in his analytical attack of the problem. In short, the methods and reasoning which should be applied in determining how far to go with meter maintenance, and frequency of routine checking and repairing, to yield something in the neighborhood of maximum returns on the investment.

While many articles have appeared on this topic, telling the reader how much he *should* do, Mr. Taylor's article strikes a contrasting keynote by cautioning against getting onto the other horn of the dilemma of income loss by doing more than can be proven justified. The important part is that he gives a "formula" for the solution.—Editor.

being used or wasted daily by flush tanks, refrigerating and air conditioning equipment, cellar drainers, and small insidious leaks.

Others have launched into their subject very vociferously, admonishing you if neglectful of the many details necessary to obtain the very highest perfection. Such, they insist, to be highly essential if you are to obtain the utmost in efficiency in your plant. Some have described and displayed photographs of elaborate and expensive-looking buildings and equipment, and have described such rigid specifications that the general effect has been rather frightening or bewildering to many operators who either have not standard routine system for meter maintenance or who are following such a system in a very moderate or superficial way.

To some operators in small towns, that we have talked with, this warning of lost revenue from under-registering meters has been similar to someone yelling "mad dog" at a Sunday School picnic. They feel that a vicious monster is lurking in their midst, but they do not know just exactly how to go about finding him.



The Testerate Indicator*

The spinning top-shaped rotor inside of the calibrated glass tube moves up and down with flow adjustments. In photographed position it is indicating a flow of 3 g.p.m.

(Photo by Courtesy Ford Meter Box Co.)*

They would like to augment their meter-shop equipment and set up a satisfactory routine meter maintenance plan, but they lack the sales argument needed to persuade the small town "powers that be" on the idea. With nothing more tangible than an estimate, the "bosses" cannot quite figure how the succeeding financial statement will look after this "necessary" expenditure, and you know the "powers that be" hate red ink. And woe unto him who is responsible for it.

There now; you have already guessed it. If you can show into which side of the financial statement the net results will accrue, you will have won your first point. If you find that you are going to spend a dollar on maintenance to gain sixty cents, you haven't a very attractive sales argument; but if you can prove that for every sixty cents spent you can gain a dollar, you have a very strong argument for the investment proposed.

"As Your Meters Go—"

It is of course a very logical and well-known fact that the proper maintenance of any piece of equipment is absolutely essential to obtain any degree of efficiency, and this fact is tremendously true with respect to water meters. No truer words were ever spoken than those of the meter superintendent who warned: "As your meters go; so goes your revenue."

It is not our intention to convey to you the impression that every one is letting their meters "go to the dogs," because especially for the last few years there has been an increasing interest shown in this most important element in water plant operation. We do believe, however, that many of those who have been making very valiant efforts to properly solve the problem have had some difficulty in establishing fundamental factors for accurate comparison and consideration in making decisions as to how far to go.

For instance, many of us have done what we thought was a good job of meter maintenance, and at the end of the year experienced an expected and gratifying increase in revenue. The following year we did exactly the same thing and experienced a slight decrease in revenue. This brings up the currently popular—So what? How much of the increase was the result of maintenance and how much was due to an increase of consumption? How much more would the decrease have been if we had not been following quite so expensive a maintenance program?

Yes, it is true that we could compare our total pumpage or output for two years. However, with routine flushing through the fire hydrants and blow-offs, the usual number of conflagrations (the quantity of water used for all of which is estimated) and with the problem of comparing consumption billed with the quantity produced (after making an allowance for under-registration of meters to obtain our percentage of unaccounted for water) what do we know about the accuracy of our meters? In plain words—next to nothing!

It is equally true that we could compare our accounts receivable for that quantity for this year with the corresponding figures for last year, and what information will we have with respect to the accuracy of our meters? Again—nothing!

Suppose your total quantity showed an increase of 10% over last year and your accounts receivable showed a gain of 8%—would that mean anything? No! Any old meter under-registering 50% will show an increase in the total registration if more water is put through it, but that fact has no bearing on its accuracy.

Enigma of Estimates

Every line of reasoning that we followed terminated with the same type of answer—an estimate.

When the day is over and your cashier checks the cash register, would you be satisfied with an estimate of your collection for the day? Well, we considered water through the meter as like dollars through the cash register, and we wanted something more definite than an estimate of the accuracy or performance of our meters.

There are many factors that will, in various degrees, very materially affect your maintenance program. Your water may be soft or hard, and if hard you may be operating a softening plant. It may have a low or high pH value (being corrosive or non-corrosive), and if corrosive, you may be treating to prevent such corrosion. It may also vary in other mineral content, etc., etc.

With these factors confronting you, let's see what we can do about evolving and establishing an economic schedule of meter maintenance, based on as many tangible facts and with as few estimates as possible.

Some Local Metering History

Our city is one of the younger cities, the water plant being started on August 15, 1882. Our water plant has grown just like many another plant, rather frantically at first in an effort to keep abreast of the rapid growth of the town and later, after obtaining some maturity, along more carefully laid plans.

About twenty years ago we were better than ninety per cent metered, and we suddenly realized that we had become "grown up" and that some routine system of meter maintenance should be established. (Incidentally may we say here that the other ten per cent of our services have long since been metered.) We equipped, in a moderate way, a meter shop, employed a trained expert, and began a plan. The Billing Department made out orders to remove for repairs each month all meters that showed an appreciable drop in registration in addition to those that had stopped entirely. This plan, although far from perfect, was continued until about eight years ago. At that time we further augmented the equipment in our meter shop and inaugurated a more modern and comprehensive plan of meter maintenance. We began at that time to remove, in addition to those meters that were reported, all meters that had been in service without attention for five years or longer, whether they showed any apparent drop in registration or not. We had heard that this was the thing to do.

After following the five year plan for several years and carefully checking a weekly report from our meter department and recapitulating these weekly reports at the end of each calendar year, we felt that the five year interim might well be extended on the basis of economic soundness. So, we decided in 1933 to adopt a six year plan. The results obtained during that year were so close to those obtained on a five year basis that we then decided at the beginning of 1934 to try a seven year plan, and this interval of time has proven *in our case* to be the most economical of all.

We Adopt the Seven Year Plan

In following this seven year plan, we begin at the first of each year to make orders for the removal and test of every meter that has been in continuous service at one location for seven years (calendar year basis) beginning with meter readers book number one, all of which are arranged geographically. We do not attempt to pick out those meters that are exactly seven years old to the month or day. For instance, beginning with 1939 we are removing all meters that have been in continuous service since 1932. We spread this work over the entire year, so that there is no sudden extra load put on our meter department at any one time of the year.

It is true that a meter installed the first of January, 1932, and removed the last of December, 1939, has seen eight years of service, and one installed tbe last of December, 1932, and removed the first of January, 1939, is only six years old, but the average over the year will be seven years, and we have found this method of removal the simplest, most economical, and the most satisfactory for any interval of time that may be necessary.

Table 1 shows the amount of work accomplished by our meter department for the years 1936 and 1937.

TABLE 1

ANNUAL METER TRAFFIC THROUGH METER DEPARTMENT

	1936	1937
Meters Reset (Reinstalled)	2,335	2,155
Meters Removed for Test (Seven Year Plan)	1,699	2,078
Meters Removed for Termination of Contract	1,880	1,843
Meters Removed for Non-payment	268	211
Meters Removed to Secure Contract	135	125
New Meters Tested	200	250
	6,517	6,662
Total Meters Tested	4,182	4,507
Total Meters Requiring Repairs	1,836	2,226

Some Testing Procedures and Discoveries

Up to the present year our 5/8" meters have all been tested on orifice streams of ½", ¼", 1/16" and 1/32". With a varying pressure during the day, it was practically impossible, with many methods of control, and even with orifices calibrated frequently, to obtain consistent rates of flow through our meter tester. Take the 1/16" orifice as a case in point; we knew that under the most careful supervision that our flows in gallons per minute through this orifice varied during the day from 0.9 to 1.1 and in the same proportion through the other orifices. Such a condition is a serious obstacle in obtaining satisfactory results in following any testing specifications in a meter shop, and results obtained are very uncertain.

The Testerate Indicator Appears

During these years we constantly felt the need of some method or piece of equipment that would enable us to obtain conveniently and quickly any predetermined rate of flow through our meter tester, regardless of varying pressures. In other words, we wanted to be sure that every meter was being tested under exactly the same conditions. Only recently such an instrument was presented to the water works trade, and we immediately placed our order for one. This instrument is known as the "Testerate Indicator," pictured in the accompanying photograph.

The Testerate Indicator is a special "Rotameter" adapted for connecting to the outlet of any meter tester and will show rates of flow from .01 g.p.m. to 30 g.p.m. The principle of this instrument is an old one, and we are surprised that some of us had not thought of utilizing it for this purpose long ago .This instrument we consider a real gift to the water works profession, and one that we believe will open up to the average water plant many possibilities not possible heretofore. Since our receipt of the Testerate Indicator we have for the last few months run many exhaustive laboratory tests on

Impoverished Test Hand
On the left is the cardboard test hand used to reveal the least flow productive of spindle movement

over 1500 meters. The results of these tests, together with the data obtained from our meter shop reports for the last several years, have revealed many interesting facts, some of which we wish to enumerate.

With the institution of a definite plan for meter maintenance such as ours, it is important to determine as near as possible the approximate percentage of total use of water at various rates of consumption in the average home. It is necessary also to ascertain the average total monthly consumption of water in the average home. We have determined these facts as follows:

Study of Consumption Rates

With the aid of a Recording Register and a very sensitive and accurate meter, we have taken records over a period of several years at the residences of various classes of people served. With the information thus obtained, and a careful analysis of local conditions, for the average residential consumption we have compiled data (Table 2) showing percentages of total consumption drawn at the various rates indicated.

TABLE 2
RATES OF CONSUMPTION IN ROANOKE RESIDENCES
(Approximate Percentages of Total Use at Various Rates Through 5/8 In. Meters.)

Rate—G.P.M.	Per Cent Used
.25	5
.5	6
1.0	8
2.0	31
5.0	40
10.0	10
	100%

These rates may vary slightly in various communities depending upon the following conditions:

1. The age of the city or town in question. (A young town will have less old leaky plumbing.)

2. The size of the standard service pipe and plumbing. (The ¾" service pipe will give slightly greater percentages on the higher rates of flow than ½" service pipe.)

3. Whether the city or town is mainly industrial or residential. (The more the wealth per capita the greater the monthly consumption, and vice versa.)

In determining these rates of consumption we were naturally rather apprehensive of the consumption of flush tanks. We felt, and others with whom we have talked also did, that the flush tank was one of the serious offenders. To obtain the actual facts we ran fifteen flush tank tests on our meter tester with the Testerate Indicator connected in series with the flush tank, the results appearing in Table 2-a.

Flush Tank Requirements and Losses

The average flush tank requires 4.120 gallons of water to replenish the water in the toilet bowl and to refill the tank. The capacity of the tank itself is only 3.603 gallons.

TABLE 2-a
RATES OF FLUSH TANK FILLINGS
(Averages from 15 Tests)

First	3.830 gallons at from	7	to 1	g.p.m.
Next	.058 gallons at from	1	to .5	g.p.m.
Next	.058 gallons at from	.5	to .25	g.p.m.
Next	.058 gallons at from	.25	to .15	g.p.m.
Next	.058 gallons at from	.15	to .12	g.p.m.
Last	.058 gallons at from	.12	to 0	g.p.m.

Assuming that the average meter in service will register 100% from 7 g.p.m. down to 0.5 g.p.m. and only 80% (this is low) from 0.5 g.p.m. down to 0.25 g.p.m. and 20% from 0.25 g.p.m. down to 0.15 g.p.m. and 0% from 0.15 g.p.m. down to 0 g.p.m., your total loss would be only 0.174 of a gallon each time the average flush tank is flushed—almost six flushes to effect a possible under-registration amounting to one gallon.. This is equal to less than one and one-half pints or 4.2% of the consumption through the average flush tank. Now if the assumed 45% of water used at the average residence is used in toilet flushing, then only 1.89% of your total consumption is lost by under-registration in this manner. This eliminates the flush tank from the "bugbear" classification.

Determining Weighted Average Accuracies

After obtaining the data regarding rates of consumption, we made a determination of the average total consumption per month of domestic consumers. In order to obtain this figure accurately, it was necessary to take off of each of over 16,000 domestic accounts the annual consumption, and by simple arithmetic to deduce therefrom the average monthly domestic consumption, which in our city is 3,000 gallons per month.

With this information we were ready to determine the weighted average accuracies of various classes of 5/8" domestic meters. However, before doing this we decided to find out what a new meter would do. This computation is shown in Table 3.

TABLE 3
WEIGHTED AVERAGE ACCURACY
(Average New 5/8 Inch Meter, as Received From Manufacturer)

Rate—G.P.M.*	% Used*	% Registered	Computation
.25	5	97.3	.05 × 97.3 = 4.865
.5	6	99.8	.06 × 99.8 = 5.988
1.0	8	100.4	.08 × 100.4 = 8.032
2.0	31	100.5	.31 × 100.5 = 31.155
5.0	40	99.9	.40 × 99.9 = 39.960
10.0	10	99.2	.10 × 99.2 = 9.920
Total % Registered			= 99.920

* From Table 2.

The percentages of registration, as shown in Table 3, were obtained by testing many new meters of several different makes, and it is interesting to note the increase in precision with which meters are being built by some of the manufacturers in recent months. For instance, Table 4 shows the results obtained in testing twelve meters picked at random from a large number recently received from the factory. The number tested included six of one make and six of another.

TABLE 4—TEST OF TWELVE NEW METERS

Meter No. / G.P.M.	1	2	3	4	5	6	7	8	9	10	11	12
	Registration Per Cent											
15	100	100	100	100	100	100	100	98½	98½	98½	99½	98½
10	100	100	100	101	100	100	100	98½	98½	98½	99½	98½
6	101	101	101	101	101	101	101	99	100½	98½	101½	99½
3	102	102	101½	102	102	102	100½	99½	101	100	101½	100
2	102	102	102	102	102	102	102½	100½	102	101	102½	101
1	102	101½	98½	102	102	102	101	100	102	100½	102½	100½
.5	100	100	100	100	100	100	101	98½	99½	99½	99	100½
.25	102	100	100	100	100	100	101	100	96	100	101	101
.1	98	98	100	99	99	99	95	90	90	100	100	98
.05	R	R	R	R	R	R	R	R	R	R	R	R
0.25			R			R	R					R

R Indicates the Test Hand Moved

You will note that all of these meters registered 90% or better on one-tenth of a gallon per minute. All of these meters also moved on five hundredths of a gallon per minute, and four of them moved on twenty-five one-thousands of one gallon per minute, and this rate, as you may well conclude, is not even a small trickle, but individual drops at the rate of approximately between one hundred and ninety and two hundred and ten drops per minute. Incidentally the Testerate Indicator was used to measure this rate of flow, it being graduated down to *one one-hundredth* of a gallon per minute. In order to determine if these meters moved at this rate of flow, we improvised a test hand of special length made from cardboard, as shown in an accompanying photograph.

We removed the register and placed a large piece of white cardboard over the main casing of the meter after cutting a small hole in the center of the cardboard. Through this hole we attached a long cardboard hand to the register spindle gear with a piece of wire in the shape of a horse shoe. We then set the Testerate Indicator at the predetermined flow and allowed a drip at this rate to continue for approximately thirty minutes, having previously marked the cardboard base at the end of the large test hand with a pencil. At the end of the half-hour this hand had moved approximately one-half inch.

Another photograph shows our meter tester with the Testerate Indicator installed, while six ⅝-inch meters and one 2-inch meter are in place for testing. On the left may be seen the scales for weighing the water which flows into a ten cubic foot tank. It may also be seen that this was originally a single meter tester and has been converted into a six meter tester. We hope sometime in the future to replace this tester with two new ones capable of testing six meters each at one time.

Weighted Average Accuracies of Meters

In Table 5 we show the weighted average accuracy of the average modern meter after one year of service.

TABLE 5
WEIGHTED AVERAGE ACCURACY
(Average Modern ⅝ Inch Meter After 1 Year of Service)

Rate—G.P.M.*	% Used*	% Registered	Computation
.25	5	85.0	.05 × 85.0 = 4.250
.5	6	90.0	.06 × 90.0 = 5.400
1.0	8	98.0	.08 × 98.0 = 7.840
2.0	31	101.0	.31 × 101.0 = 31.310
5.0	40	100.3	.40 × 100.3 = 40.120
10.0	10	99.6	.10 × 99.6 = 9.960
Total % Registered			= 98.880

*From Table 2.

In Table 6 the weighted average accuracy is shown of the average modern meter after seven years of service.

TABLE 6
WEIGHTED AVERAGE ACCURACY
(Average Modern ⅝ Inch Meter After 7 Years of Service)

Rate—G.P.M.*	% Used*	% Registered	Computation
.25	5	65.0	.05 × 65.0 = 3.250
.5	6	88.0	.06 × 88.0 = 5.280
1.0	8	96.5	.08 × 96.5 = 7.720
2.0	31	100.1	.31 × 100.1 = 31.031
5.0	40	99.2	.40 × 99.2 = 39.680
10.0	10	99.0	.10 × 99.0 = 9.900
Total % Registered			= 96.861

*From Table 2.

May we say that some of these meters when received from the manufacturer registered slightly over 100% at rates of one gallon and two gallons per minute and were installed without any change to determine the amount that they would "build up" or "speed up." You will note that in the first year of service these meters lost registration on 0.25, 0.5, and 1.0 g.p.m. rates, but gained on the 2.0, 5.0, and 10.0 g.p.m. flows. After seven years of service, however, these meters had lost registration on all rates of flow. (More will be said about this later.)

The ⅝-inch domestic meters in our system vary in age from a few months to slightly more than thirty years, averaging about fifteen years of age.

Our next step was to determine the characteristics of this *average* meter in our system. To do this we removed and tested a large number of meters with records of various lengths of service, without having received any attention. We picked at random from the entire area which we serve.

Those meters removed from an area comprising 30% of our total distribution system, which is served by an impounded supply of soft water of a hardness of less than one grain per gallon, showed an average "build up" of from 0.5 to 1.3% on some rates of flow.

About two years ago we began treating this supply with lime to raise the pH in an effort to remove a moderate accumulation of tubercles from this portion of our distribution system and the transmission main serving it, and to prevent further corrosion. This application of lime was started very sparingly, and the dosage gradually increased over the period under the careful supervision of our chemist and bacteriologist. During this time we have pursued a carefully planned system of periodic flushing, varying in frequency in different parts of the section served.

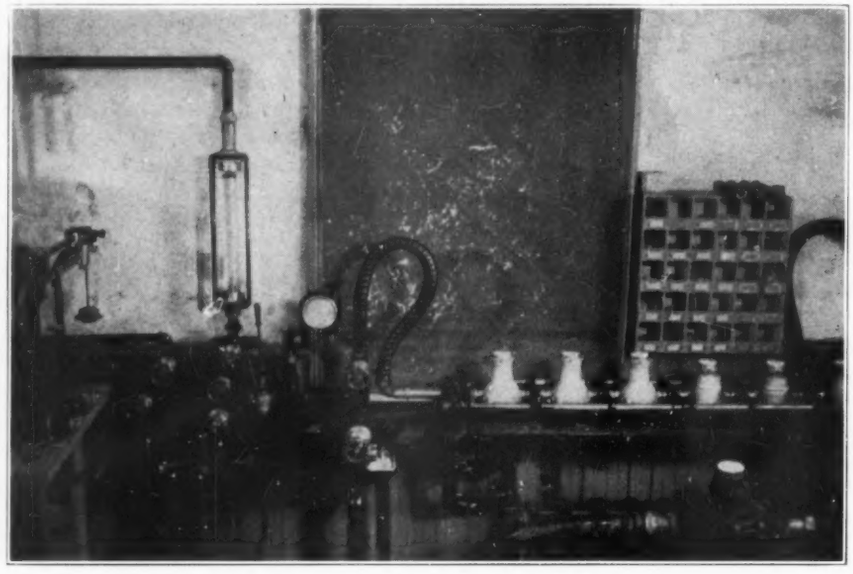
This plan of treatment has been, and is at the present time, producing very encouraging results, and a very gratifying quantity of tuberculation in the form of iron oxide is being loosened and flushed from this portion of our system.

An iron bearing film seems to be the cause of the registration "build up." It gradually accumulates on the walls of the disc chambers and on the discs in the form of a thin, even, brown, slick coating which thoroughly seals the points of leakage or "slippage." In

addition to this it also acts as the best lubricant that we have ever seen, especially on the low rates of flow. We often remove meters from this section of our system that test from 95% to 100% on 0.25 g.p.m., even after several years of continuous service.

The other 70% of our distribution system is served from other supplies yielding relatively hard limestone water (approximately eight grains per gallon), and there is no "build up" apparent in the meters in service in this section. Of course, some of the meters in this section will show a slight increase on the low rates of flow after a few months use. However, this is the natural result of "loosening up" or "breaking in" as a result of use, just as your new automobile engine increases in smoothness and efficiency after the first one thousand miles.

With all of the aforementioned facts we were then ready to proceed further. Please bear in mind that we had been removing meters on a five- six, and seven-year plan for eight years, and these records were very carefully reviewed. However, our past records did not include tests on the 0.25, 0.5, and 2.0 g.p.m. rates, except that with the 1/32 inch flow we did determine whether the meter would run or not. We felt that now, with the aid of the Testerate Indicator, we could obtain pertinent facts with a new degree of certainty. Please also bear in mind that when we refer to average meters we mean meters of all ages from the newest to the oldest, also that there is not a single meter in our system that has been in continuous service for more than 7 years without attention.



Meter Tester with Testerate Indicator

Six 5/8 in. meters and one 2 in. meter are in place for testing. On left, scale beam of 10 cu. ft. weighing tank.

We found that our average meter that had been in service for one year tested as shown in Table 7, which may be interestingly compared with Tables 5 and 6.

TABLE 7
WEIGHTED AVERAGE ACCURACY

(Average 5/8 Inch Meter, of Various Ages, After 1 Year of Service Since Passing Through the Shop in Routine Maintenance)

Rate—G.P.M.*	% Used*	% Registered	Computation
.25	5	67.0	.05 × 67.0 = 3.350
.5	6	81.0	.06 × 81.0 = 4.860
1.0	8	96.8	.08 × 96.8 = 7.744
2.0	31	101.0	.31 × 101.0 = 31.310
5.0	40	100.3	.40 × 100.3 = 40.120
10.0	10	99.4	.10 × 99.4 = 9.940
Total % Registered			= 97.324

* From Table 2.

We also found that our average meter (various ages) that had been in service for seven years, since shop checking, tested as shown in Table 8, which may be interestingly compared with Table 7.

TABLE 8
WEIGHTED AVERAGE ACCURACY

(Average 5/8 Inch Meter, of Various Ages, After 7 Years of Service Since Passing Through the Shop in Routine Maintenance)

Rate—G.P.M.*	% Used*	% Registered	Computation
.25	5	45.6	.05 × 45.6 = 2.280
.5	6	76.1	.06 × 76.1 = 4.566
1.0	8	92.8	.08 × 92.8 = 7.424
2.0	31	99.9	.31 × 99.9 = 30.969
5.0	40	99.1	.40 × 99.1 = 39.640
10.0	10	99.0	.10 × 99.0 = 9.900
Total % Registered			= 94.779

* From Table 2.

We also discovered that all meters that ran between 98% and 100% on flows of 1, 5, and 10 g.p.m., that would run at all on 0.25 g.p.m., would average consistently 91% on 0.5 g.p.m. and 71% on 0.25 g.p.m.

(NOTE: What has been covered up to this point will give the reader something of a picture of Mr. Taylor's studies preparatory to making a more extended analysis of facts, in attempting to define the economic limits of expenditures for meter maintenance. In the next installment the author reveals simplified meter test procedure, developed for use in connection with used meters. He also presents a Specification Chart for % registration accuracies, which has been devised for shop testing of meters taken from service for routine maintenance in the seven-year plan adopted.

Mr. Taylor then proceeds with his analysis of revenue loss expectancy vs. maintenance expense on meters of various ages, when such are put through the shop at intervals of from 1 to 10 years, in arriving at costs of short vs. long interval shop service.

This much will give the reader some indication of the thoroughness with which the author has gone into his fact finding studies to strike an economic balance between expenditure for maintenance and returns in the form of net gain in income.—ED.)

TYPHOID HELD COMPENSABLE DISABILITY

For the first time typhoid-fever has been held to be a compensable disability. Intestinal diseases have hitherto been held to be non-compensable disabilities.

In Pennsylvania the State Labor Relations Board awarded $3,000 to a worker's widow because of typhoid fever contracted assumedly from drinking water supplied workers on a construction job. The case was brought against the contracting firm and the Pennsylvania Casualty Insurance Co. by the widow of the employee who died of typhoid fever.

NEW ALL STEEL FILTER PLANT

Constructed for Citizens Water Company of New Bethlehem, Pa.

By JOHN T. CAMPBELL
Consulting Engineer*
PITTSBURGH, PENNSYLVANIA

THE Citizens Water Company is a privately owned water company supplying water to the Borough of New Bethlehem in Clarion County and the adjacent Borough of South Bethlehem in Armstrong County, Pennsylvania.

The population served is approximately 1,600, with an average daily consumption of 180,000 gallons and a maximum daily consumption of 350,000 gallons, at a pressure of 75 pounds per square inch.

The Old Plant

Previous to the new installation, the plant consisted of the following: two 500 g.p.m. gas engine driven pumps located in a pumping station on Redbank Creek, pumping water through a 10-inch cast iron line to a filter plant located on the hill above the pumping station; two rectangular settling basins having a combined capacity of 270,000 gallons; a filter plant consisting of two circular New York Continental Jewel filters—one 8 feet in diameter rated at 100 g.p.m. and the other 12 feet in diameter rated at 226 g.p.m.; a clear water basin having a capacity of 22,000 gallons, located beneath the filters in the filter building; and a 10" cast iron gravity main from the clear water basin to the distribution system in the boroughs.

The Jewel filters were the oldest in the State of Pennsylvania and were installed in 1889 and have served successfully, with some slight repairs, up until the present time. The method of filtering, however, afforded considerable opportunity for improvement, as the water was pumped to the two large settling basins on the hill, from whence it flowed by gravity to the filters and thence into the small clear water basin below and, in times of large demand, the rate through the filters was increased beyond the point considered safe and the storage available for maximum domestic and fire demand was raw water instead of

*Campbell, Davis and Bankson—The Chester Engineers.

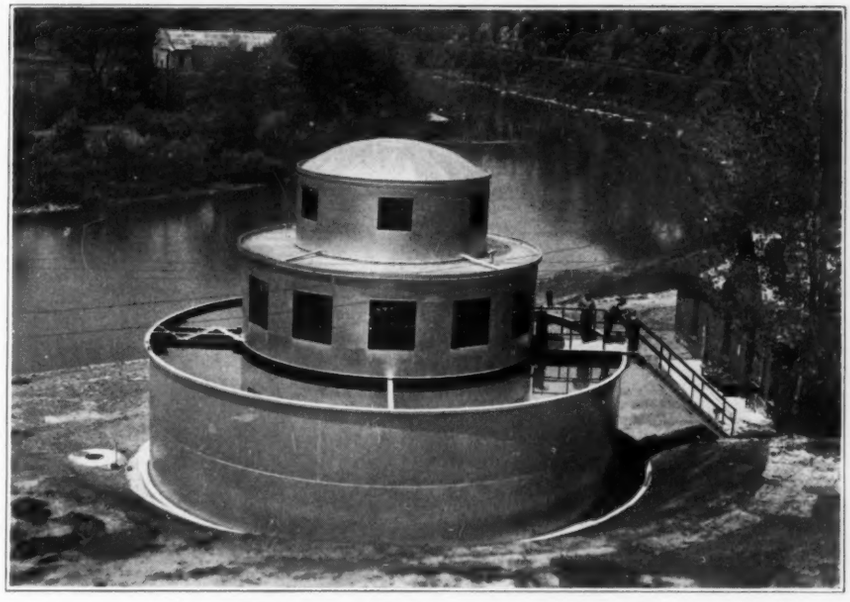
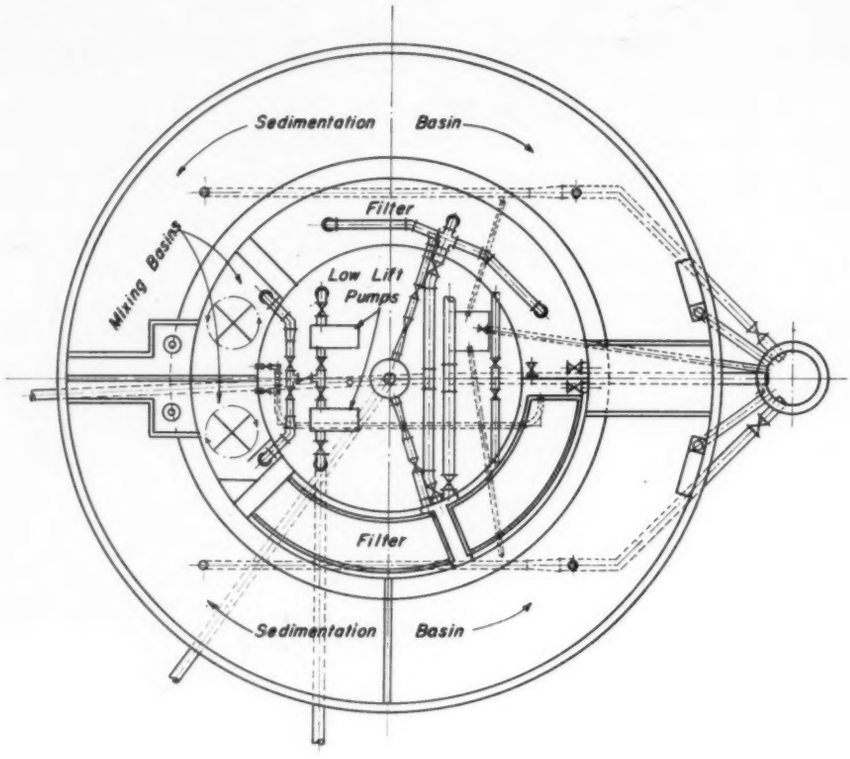
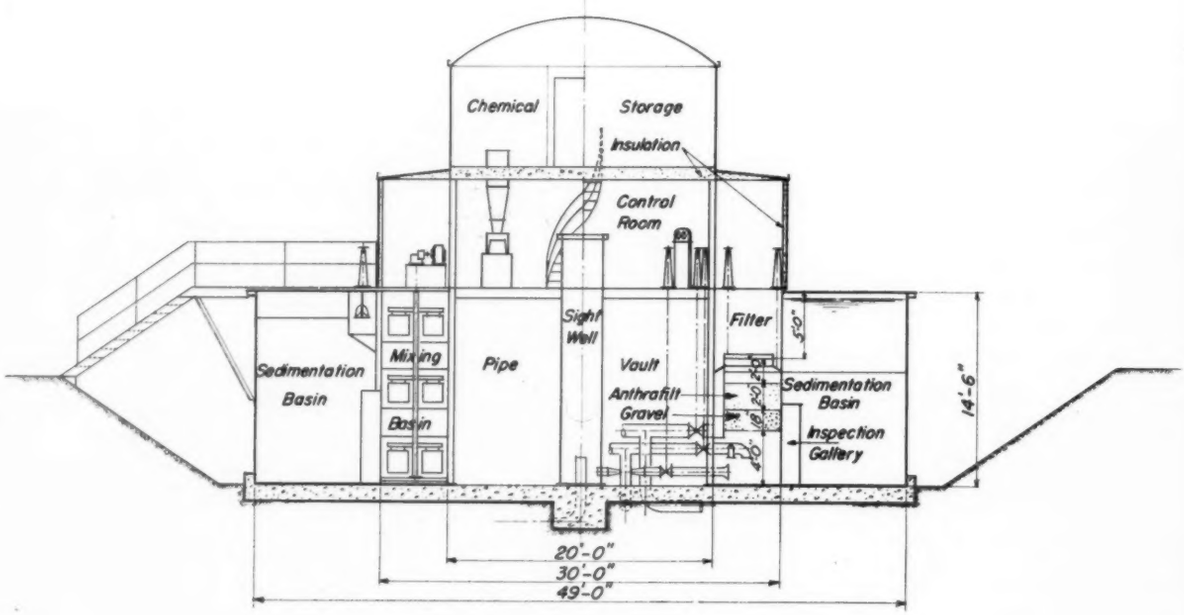


Fig. 2: The Completed Plant—Cap. 720,000 G.P.D.
(Showing location with reference to creek and High-Service Pumping Station, lower right.)

Fig. 3: The Control Room
(Showing combination filter gages, dry-feeders, chlorinator, and the very useful center sight-well.)



SECTIONAL PLAN



SECTIONAL ELEVATION

FIG. NO. 1

CITIZENS WATER CO.
NEW, BETHLEHEM, PA.
ALL STEEL FILTER PLANT
PLAN & SECTION
Scale:- 1/8"=1'-0"

filtered water. In addition, chemicals were fed in at the pumping station at a considerable distance from the filter plant and there was little opportunity for close control over the amount of coagulant used.

Choice of New Design

The proposed plan of improvement contemplated the construction of a filtration plant adjacent the pumping station and utilizing the present settling basins as clear water storage thus centralizing the pumping and filtration, giving better chemical control and making available the large storage capacity on the hill for filtered water. Two schemes were proposed—one the construction of the usual concrete settling basins and filters with brick superstructure housing the chemical equipment; and the other an all-steel filter plant of the Morse type.

Calculations were made as to cost of each of these schemes and it was found that whereas the usual filter plant construction would cost $32,000, the all steel plant could be put in for $29,000. In view of the saving of approximately ten percent of the cost and it was decided that an all-steel filter plant would be constructed.

The New Plant

The filter plant (see line drawing) consists of a circular sedimentation basin which occupies the outer ring, this ring being 49 feet outside diameter and 30 feet inside diameter, providing a 4 hour sedimentation period. Two (2) mixing chambers and two (2) filters are located in the circular section adjacent to the sedimentation basin. The two mixing chambers have a detention period of 20 minutes and the filters are designed for filtering 500 gallons per minute at the rate of 2 gallons per square foot per minute. A pipe vault occupies the inner cylinder (tank) which is 20 feet in diameter and formed by the inner walls of the filters and mixing chambers. In the center of this pipe vault there is installed a 30-in. diameter sight well which extends through the floor of the control room and is provided with a plate glass top. This sight well is lined with glass brick and provided with a vaporproof light at the bottom so that the quality of the water, after it has passed through the filters, can be determined visually.

The control building completely houses the filters and mixing basins and a second story over the control house is provided for the storage of chemicals. Low lift motor driven centrifugal pumps, each having a capacity of 500 g.p.m. are installed in the pipe vault, taking their suction direct from the creek and discharging into the mixing chambers where chemicals are applied from dry feed machines located on the main operating floor over the mixing chambers. The water then passes into the sedimentation basins and thence to the filters and into the clear well beneath the filters, from which it passes through rate controllers into the sight well and thence to the suction of the high service pumps.

Perforated Plate Filter Bottoms

The filter material consists of 18 inches of graded gravel resting on a steel plate which is perforated on 6 inch centers with 3/8" holes. A diffuser is provided over each hole. On top of the gravel 24 inches of "anthrafilt" (crushed and graded anthracite) is placed and the tops of the steel wash troughs are located 2 feet above the bed surface.

Figure No. 1 shows the plan and cross section of the plant. Figure No. 2 is a view of the plant, showing its location with reference to the creek and the high service pumping station below on right. Figure No. 3 is a view of the control room showing the indicating filter rate-control stands and loss-of-head gages, chlorine machine, dry feed machines and sight well in the center. Figure 4 is another view of the control room showing the backs of the indicating rate controllers, chlorine machine and spiral stairway leading to the chemical storage on the second floor. It also shows the table for making routine chemical tests. The low service pumps can be started from the operating floor, ejectors for priming having been installed together with a suction gauge.

This plant was placed in operation on June 1st and is giving entire satisfaction. The plant was constructed by the Chicago Bridge and Iron Company, Mr. John Pirok being in charge of construction for this company. The Chester Engineers of Pittsburgh, Pa., served as Consulting Engineers for the Citizens Water Company.

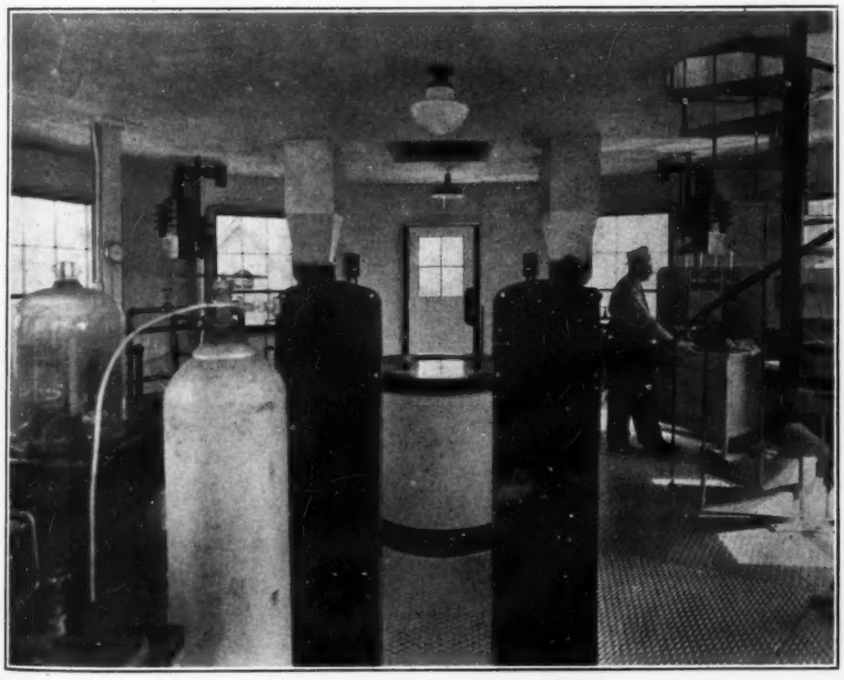


Fig. 4: The Control Room

(Showing table for making routine operating tests and stairway to chemical storage in the "turret-house" above—see elevation sketch.)

IDAHO WATER SUP'T. HEADS STATE ENGINEER-BOARD

Wm. P. Hughes, City Engineer and Sup't of Water, Lewiston, Idaho, who has just completed a three-year term as Director of A.W.W.A., has been named chairman of the Idaho Engineering Board.

This board, created this year by the State legislature will direct the engineering profession in Idaho, conducting examinations for licenses and investigating and ruling on charges of misconduct brought against members of the engineering profession. R. G. Briggs, Consulting Engineer, Boise, is Secretary of the new Board.

DETECTING WATER WASTE BY OBSERVING SEWER FLOW

Will Also Serve to Run Down Water Theft

By D. D. GROSS, Chief Engineer
Board of Water Commissioners
DENVER, COLORADO

COLORADO'S pioneers came looking for gold, but stayed to learn that when the welfare of man is considered, water is more valuable even than the glittering nuggets which spelled wealth to the fortunate.

The gold-rush with the famous slogan "Pike's Peak or Bust", resulting in the founding of Denver and the settlement of Colorado, started in 1858. In 1859 the first irrigation ditches near Denver were constructed, but Denver's first municipal waterworks did not start to function until 1871. As Colorado grew the demand for water grew and as the demand for water grew the laws governing the use of water grew. The water laws provide that "the first in use is the first in right" to water flowing in Colorado streams. As the requirements of water for irrigation developed faster than the requirement of water for municipal purposes, Denver found it necessary to buy rights to the use of water from ditch companies and farmers and to build reservoirs to store flood waters, and ultimately, at great expense, to tunnel the Continental Divide and bring water through the mountains from the headwaters of the Colorado River.

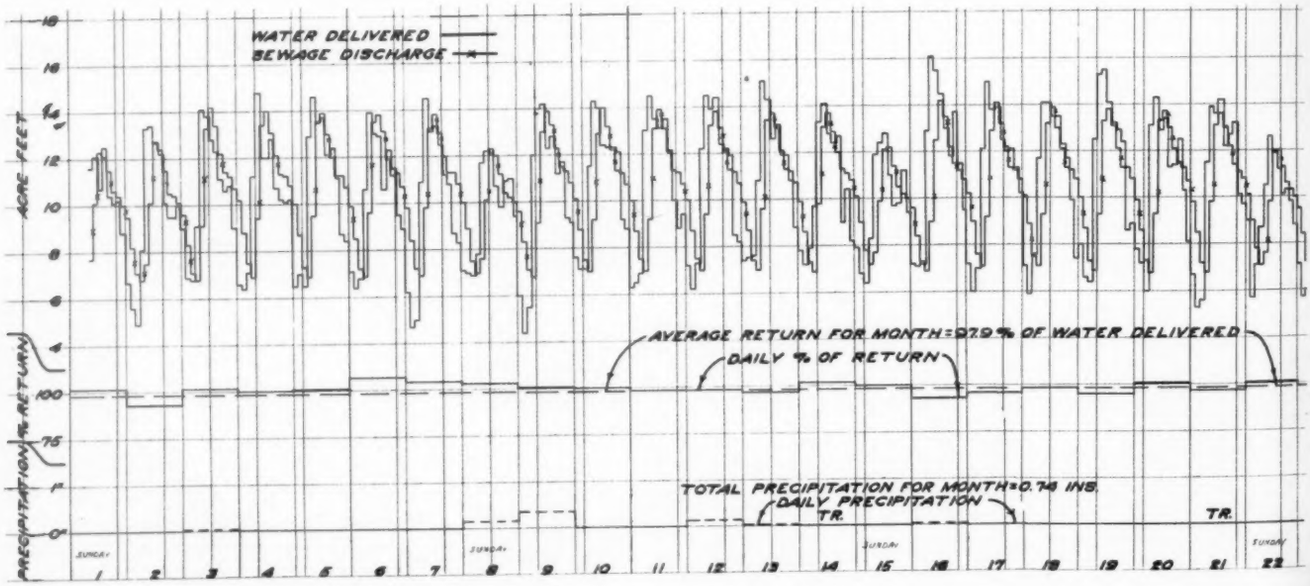
The Author

When water is applied to the soil by irrigation part of it is taken up by evaporation, part is used by plant growth, and a large part percolates down into the soil and ultimately finds its way back to the river channel. The return water, of course, can again be used by ditches heading down stream. As a stream leaves the foothills with a flow of water derived from the melting snow on the high mountains and flows out across the plains, its channel is emptied of water by irrigation many times and again replenished by the return water. While one might expect the ditch heading close to the foothills to have the best rights, it is a fact the ditches down stream often fare better, as their supply is drawn largely from a reservoir of underground water and is not so readily affected by dry weather.

If Denver bought ditch rights and proposed to take the water thus acquired at the city's intake works at the edge of the foothills, other ditch companies would object on the grounds that taking the water from irrigation purposes and piping it to Denver would deprive them of return water they had been using and ruin their rights.

The Importance of Returned Water—Sewage

There seemed to be a policy on the part of irrigation interests to institute litigation to prevent Denver



A Portion of Water Supply—Sewage Discharge Record for January, 1939

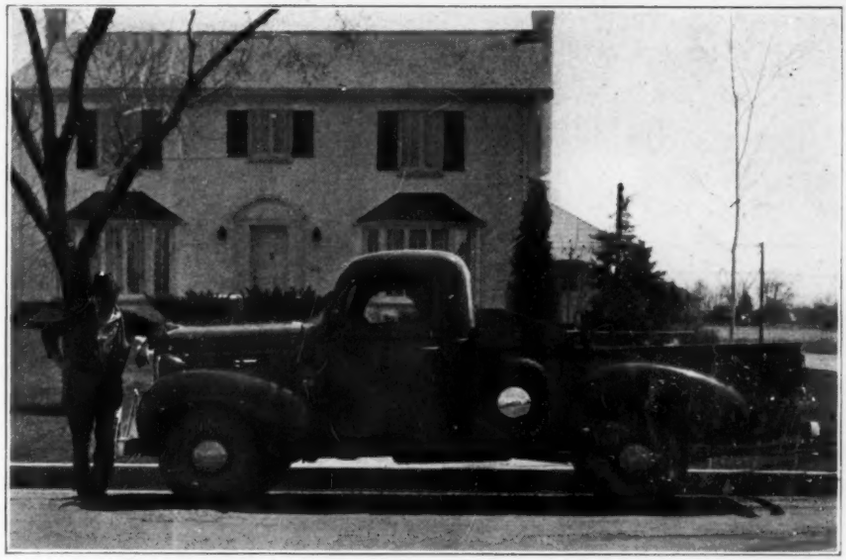
(Note that sewage flows lag behind water use rates by roughly two hours. Note also that sewage flow for month average almost 98% of water supplied distribution system in a month of negligible infiltration expectancy.)

from obtaining more of the direct river flow and force Denver to provide more storage reservoirs and store more flood water in order to increase return water of value to the irrigationists. For these reasons it became very important that Denver have available complete and accurate information as to the per cent of water that was returned to the river through the sewers as well as a record of that taken into the water supply system.

Now we know that when water is used for domestic purposes a larger per cent is returned to the river than is the case when it is used for irrigation. It is important to have definite figures to show the ditch companies, and to use in court proceedings, to prove what the facts are. We do not consider it good form in Colorado to talk about the *consumption* of water; it is better to say the *use* of water, fostering the thought that after use much of it is returned to the river. So, we must consider two kinds of water—"New and Used."

To get at the facts as to the per cent of water used in Denver that was returned to the river we began in 1926 the keeping of records showing the flow of water through the sewers. Charts are prepared on which are shown the use of water in the city. That is the flow of water as metered in the supply conduits, and this flow corrected for loss or gain in the city distribution reservoirs. On the same charts are plotted the amount of flows in the sanitary sewers. This information is computed and plotted for two hour periods throughout the 24 hours of the day and shows the rise in the use of water to a maximum during the peak hours, usually about 11:00 a.m., and the fall to a minimum, usually about 5:00 a.m. There is a two hour lag between time of change in discharge through the city system and the time a corresponding change takes place at the regular gauging stations on the sewers. These records are kept continually throughout the year. Separate records are kept of the flow in storm sewers and gaugings of the river flow are taken to determine the seepage coming into the river within the city limits independent of the sewer flows.

With irrigationists, the popular unit of measure for flowing streams is the cubic foot per second called second feet (1 second-foot being 646,272 gallons per 24 hours); and for measuring reservoir capacity the acre foot, equal to 325,829 gallons.



Servicemen With One of Denver's Pick-Up Trucks
(Equipped with radio, tools, maps, instruments, etc.)

Sewer Gauging History

When we started these records in 1926 Denver had three main sewers discharging independently into the South Platte River and gauging stations were established on each one. Later a sewage disposal plant was installed and the flow of all sanitary sewers brought together and discharged into the plant. Now all sewage is metered as it enters the plant. However, to give more detailed information, we still maintain gauging stations on each of the main lines.

Precipitation records are plotted on the same chart with water consumption and sewer flow and in the computations allowances are made for precipitation.

What We Learned From the Records

By a study of the charts over a long period of time we learned that when water was not being used for lawn sprinkling or similar use not capable of return through the sewers, that 95% of the water used was being returned through the sewers. We take this as evidence that there was very little loss of water through leakage in th city pipe system as the ratio of "used" water to "new" water remained fairly constant as the use of water increased or decreased.

Our experience over a period of years convinces us that both the sewers and water mains are tight with very little infiltration, say 10%,

Map and Instrument Box on All Trucks

of ground water into the sewers and very little leakage from the city water mains. When leaks develop in the mains or services the water usually comes to the surface and is detected.

Denver's water services are only about 3% metered and no doubt there is considerable fixture leakage. A few years ago when we had a cycle of dry years, necessitating a publicity campaign asking the people to conserve water and avoid waste, there was a noticeable reduction in the flow in the sewers. The same condition is observed when an extensive campaign of house to house inspection of plumbing is made.

Possibilities of the Scheme and a Plan

At the suggestion of Mr. L. H. Enslow, Editor of WATER WORKS AND SEWERAGE," we decided to make still further use of our sewer gaugings to determine or detect the improper use of water (water theft) in addition to tracing possible hidden leakage of moment.

Under this plan men are sent to inspect sewer manholes for unusual flow of water. We have constantly on duty men we term "servicemen." They are provided with pick-up trucks equipped with radio, maps and tools. It is their duty to respond to all important fires, operate valves, locate leaks, post red lights, etc. At headquarters we have a foreman and two or more men always on duty. If all the men are away from headquarters it is possible for the foreman to get in touch with any one of them at any time as the police department broadcasts our messages. When not otherwise engaged the servicemen do this work. They inspect the manholes at the points where the smallest laterals discharge into the branch sewers. Most of these laterals are from one to three blocks long. No attempt is made to measure the flow. The serviceman observes the amount and makes a notation as low, medium or high, to designate the amount of flow as compared to flow in other laterals. These notes are compared when the inspection is repeated. The best time to make inspections for water wastes has been found to be between 2:00 a.m., and 4:00 a.m. At that time the regular flow is at a minimum and any unusual flow is more readily detected. If an unusual flow is discovered at night, an order is given the day servicemen the next morning to make house to house inspections and find where the water is coming from.

By following out these methods we have successfully detected and corrected waste of water. However, to date we have not detected any illegal use of water. Since the procedure of sewer flow checking can be conducted with little, if any, additional expense in plant operation, we believe it a valuable method of investigating waste of water and possibly detecting illegal use of water.

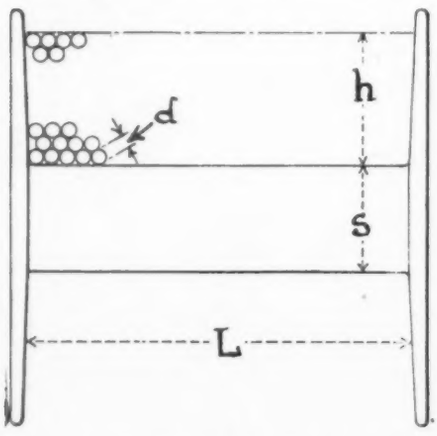
FOOTAGE WOUND ON REELS OR DRUMS

By W. F. SCHAPHORST, M.E.
NEWARK, NEW JERSEY

It is often desired to determine the total length of hose, rope, yarn, satisfactory formula for computing wire, cables, etch, on a drum or reel.

Inasmuch as I had never seen a the length of these wound up articles I tried my hand at devising such a formula. As a result I have developed what I believe to be a simpler and more practical rule and a more accurate one, than has heretofore been published. I believe it will appeal to every water works or sewerage operator, and possibly to many engineers.

When a rope or hose winds upon a drum or reel it naturally assumes a position such as I have endeavored to indicate in the sketch herewith. That is, the rope when winding onto the first layer seeks the "valleys" between the turns of the first layer. In this way the maximum length is wound onto the drum. This is particularly true if the rope is taut.



To determine the number of feet on a drum (properly wound) four measurements are necessary as shown on the sketch:—

h = depth of material on drum, inches;
S = diameter of drum, inches;
L = length of drum, inches;
d = diameter of material, inches.

The Rule

The rule is as follows: "To the depth "h" of the rope, hose, etc., add "S" the diameter of the drum cylinder, (all measurements in inches), multiply by the depth "h" in inches, then multiply by the inside length of the drum in inches marked "L" in the sketch, then divide by the square of the diameter of the rope or cable in inches, and lastly multiply by 0.3. The answer is the length in feet.

Take, for example, a drum in which h = 10 in.; S = 20 in.; L = 50 in.; and the diameter of the rope, d, is ½ in. How many feet of rope on the drum? Apply the above rule and it will be found that the answer is 18,000 feet.

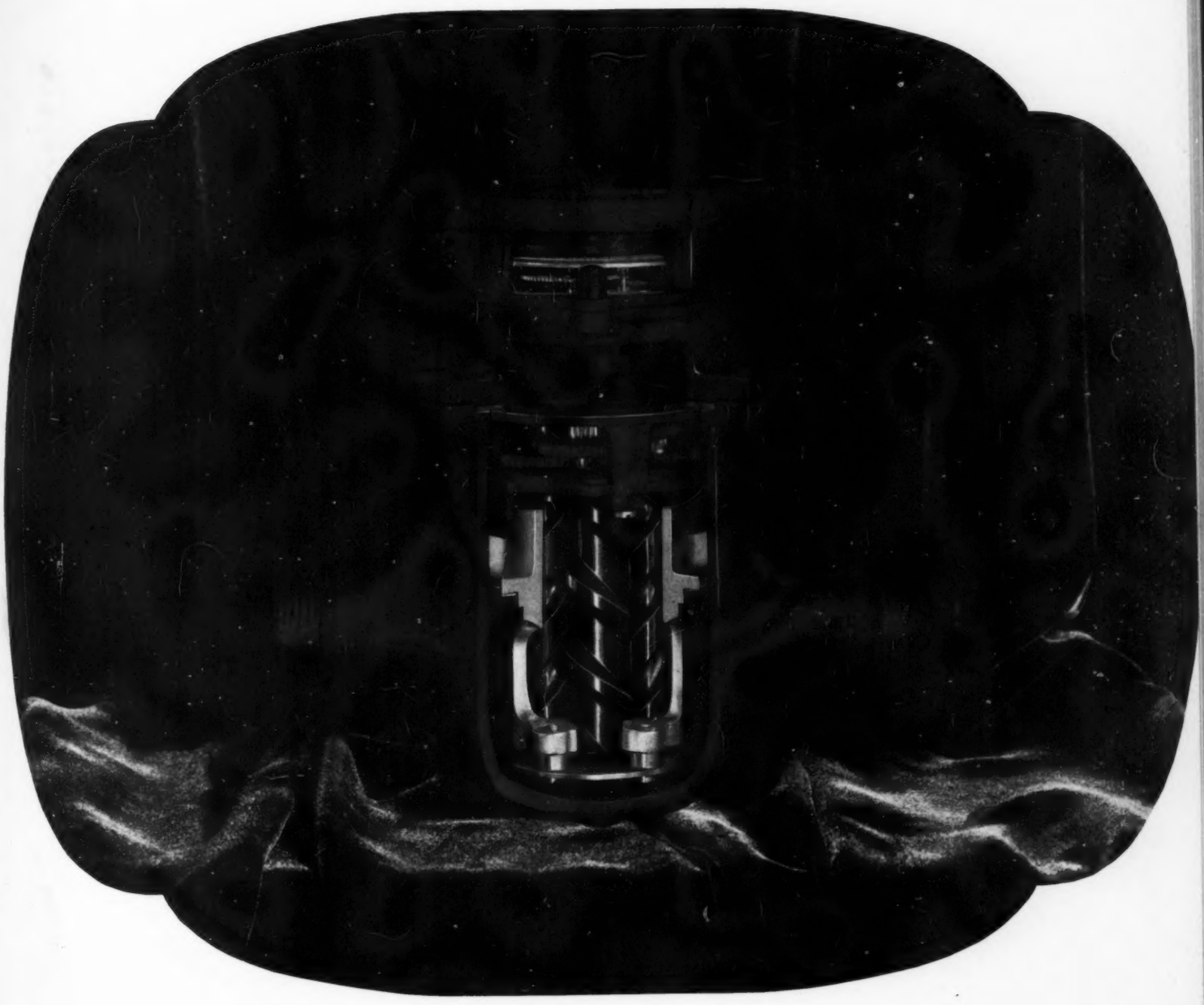
This method may not give an answer 100% accurate but it will give a pretty fair approximation of the exact footage wound on a reel or drum.

LOSING MERCURY? Look for Gold-Digger!

At Ashland, Oregon, shortly after placing the new trickling filter plant in service, a perplexed operator was considerably concerned over the difficulty of keeping mercury in the seals of the revolving distributors.

Where did the mercury go? Well, a few days of sleuthing revealed that gold-miners operating nearby had run short of quick silver for gold extraction by the amalgamation process and were "borrowing" the mercury from Ashland's distributors. (We can't vouch for the authenticity of this story. We ran across it in *The Illinois Digester*.—ED.)

The PITTSBURGH IMO WATER METER



NO OTHER METER HAS EVER BEEN GIVEN
SUCH WIDE PUBLIC ACCEPTANCE

PITTSBURGH EQUITABLE METER CO., PITTSBURGH, PA.

Over 800 Customers in 46 States Have Bought

PITTSBURGH IMO METERS

because THEY MEASURE THE LOW FLOWS

It has been estimated that between 25% and 50% of the total water used by the average household is consumed at rates of less than 1 g.p.m. It follows that if these flows were accurately measured, a considerable increase in revenue could be obtained.

The Pittsburgh IMO Meter is the solution to the low flow measurement problem. Accuracy of 98% is guaranteed at 1/4 g.p.m.—90% at 1/12 g.p.m.

These accuracy specifications definitely assure increased revenue on any service where the Pittsburgh IMO Meter is installed.

There is no other meter like the Pittsburgh IMO. It has been determined that the Pittsburgh IMO will pay for itself in a comparatively short time through measuring the trickles of water which the conventional meter will not record.

because THEY OPERATE QUIETLY

One of the most pleasing features of the Pittsburgh IMO Meter is its silent operation. Many well known waterworks executives say this silent operation would justify the use of the IMO if it were otherwise no better than ordinary meters.

The Pittsburgh IMO Meter cannot become noisy, because smooth turning rotors, precision-cut to mesh perfectly, replace noisy slapping discs. The rotors revolve with a semi-floating action and water flows through the measuring chamber in a straight line without any turbulence. Wear on rotors or measuring chamber has been shown to be negligible. The basic construction precludes the possibility of the IMO meter ever disturbing the sleep of the householder.

because THEY RETAIN THEIR INITIAL ACCURACY

The sustained accuracy of Pittsburgh IMO Meters has been proved in any number of instances. In one specific case a Pittsburgh IMO Meter which had measured over 3,000,000 gallons was torn down and checked with micrometers and calipers. Only infinitesimal wear was evidenced. *The meter tested slightly better on the low flows than when first put into service and accuracy had not changed at rates of flow above 1 g.p.m.* In practically every case where IMO Meters have been put on test by waterworks departments, the *low flow accuracy of the meter increased slightly* after the meter had been subjected to a period of service. The Pittsburgh IMO is the only meter that will retain or better its original accuracy curve after installation.

because THEY LOWER MAINTENANCE COSTS

In addition to the increase in revenue gained through accurate measurement of large and small flows alike, maintenance costs go down with the IMO Meter. This saving results from the unique design of the measuring chamber and its operating rotors. The rotors revolve with a semi-floating action and water flows through the measuring chamber in a straight line, without any turbulence. This design principle greatly increases the life of the working parts as compared with conventional meters and insures longer, trouble-free service. Due to the exact interchangeability of all IMO parts, it is possible and practical to replace complete measuring chambers, gear trains or registers without removing the meter body from the line and with every assurance that the meter will remain in proof.

The Unique Measuring Chamber — Responsible for Accuracy and Long Life

The accompanying illustrations show the fundamental elements which are responsible for the accuracy of the Pittsburgh IMO. These consist of three screws which mesh with each other and fit the bore of a casing. These screws are called rotors while the surrounding casing is the measuring chamber. Water enters the measuring chamber from the bottom and, as it is forced upwards by line pressure, causes the rotors to turn from its path. They rotate and are propelled by the surrounding medium (water) in a perfectly continuous flow. The threads on the rotors act as a continuous piston, which always moves in a forward direction. The center rotor is known as the power rotor and performs the function of driving the register through the oil enclosed gear train. The two side rotors are known as idlers, doing no work but serving as seals for the power rotor. They rotate in the opposite direction to the power rotor. Water is not brought into rotation but flows smoothly without turbulence. There is no pulsation whatsoever. The action is, therefore, smooth and free from vibration, even when operating at its maximum rate of flow.

THE ROTORS

Although the IMO is practically self-cleaning, a circular mesh strainer of 20 mesh monel metal wire completely encircles the measuring chamber and prevents large particles of foreign matter from reaching the working parts. The IMO Strainer presents more area than that used in any other meter—in fact, it has over 500% more screening surface than in some disc meters. It should be observed, however, that the IMO will stand up longer and better than any disc meter, even if the strainer is omitted entirely because the water passes through the measuring chamber without turbulence.

THE MEASURING CHAMBER AND STRAINER

Get the Complete Story —— Write for Bulletin W-529

PITTSBURGH EQUITABLE METER COMPANY
MERCO NORDSTROM VALVE CO.

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Remember PITTSBURGH IMO METERS WEAR IN WHERE OTHERS WEAR OUT

SUPERCHLORINATION AS PRACTICED IN NORTH AMERICA*

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THERE are two significant reasons why the superchlorination process of water treatment deserves to receive attention at the present time.

First, the superchlorination process has been in continuous use at a sufficient number of water treatment plants to yield evidence that control of tastes and odors by this process may be accomplished with efficiency and with economy. When such evidence is available, it is certainly of interest to the water works profession. Second, there is an insistent demand for the production of water which will meet standards of bacterial quality even more rigid than those minimum standards adopted by the United States Treasury Department. The superchlorination process offers one means of attaining a higher standard of bacterial purity in the finished water.

Development of Superchlorination

Twenty years ago, Sir Alexander Houston (1) of the London Metropolitan Water Board, referred to the taste and odor destroying properties of chlorine. In a later report (2) he describes several experiments with this type of treatment and states not only that the superchlorination method is uniformly successful, but that the more chlorine added, the more certain is the absence of taste after dechlorination.

In America, Howard (3) at Toronto, Canada, determined phenolic substances in the raw water to be the chief cause of objectionable tastes which developed when the water was chlorinated for disinfection. A complete discussion of extensive laboratory studies on the elimination of tastes and odors from this source was given by Howard and Thompson (4) in 1926. Their studies demonstrated that tastes were intensified with slight increases in the chlorine dose, but that above certain amounts of added chlorine the taste disappeared leaving only a chlorinous taste and odor. The excess chlorine could then be removed by means of a dechlorinating agent such as sulfur dioxide. Since these laboratory results were so encouraging, the superchlorination and dechlorination method was tried on a full plant scale.

The first application of this process was made on September 2 and was continued until September 12, 1926. During the period over 70 million gallons of water were treated daily with a chlorine dose between 0.6 ppm to 1.0 ppm. The corresponding dose of sulfur dioxide varied from 0.275 ppm to 0.625 ppm. Taste developed in another part of the supply which was not treated by this process and became very pronounced, resulting in complaints from consumers. Not a single complaint was received from consumers of the water treated by super- and dechlorination. The process was operated continuously from September 28 until December 8 of that year, making a total of 84 days of application. When it was stopped, tastes became general and Howard (5) reports that in 1927 city officials were satisfied as to the success of this method and provided funds for the necessary equipment to make its use continuous.

Action of Chlorine in Destroying Tastes and Odors

It has been noted by Baylis (6) that most of the odoriphore groups (this is the name applied to certain chemical groups in the molecule of the aromatic compounds) are easily oxidized and decomposed by a fairly strong oxidizing agent. The liberation of nascent oxygen from water when excess chlorine is added, and the combination of this oxygen with the taste and odor compounds, is believed to be responsible for the action of chlorine in removing these compounds.

Watzl (7) states that oxybenzenes, naphthols, and anthracene derivatives—tar, creosote oil, and the like—after high chlorination give higher substituted aromatic derivatives which, as a rule, have either no smell or only a slight smell.

A number of typical tastes and odors are listed by Baylis (6) as being susceptible to elimination or reduction by superchlorination treatment followed by dechlorination.

Methods of Dechlorination

Several methods of removing excess chlorine after superchlorination treatment have proven to be entirely practical. The method selected will depend upon local conditions of installation or operation.

Sulfur dioxide, the dechlorinating agent used in the largest number of municipal installations, is an article of commerce available in cylinders similar to the familiar chlorine container. Equipment almost identical to standard chlorinators is utilized in the measurement and application of this gas, which is readily soluble in water. Theoretically the amount of sulfur dioxide required is less than the amount of residual chlorine, *i.e.*, approximately 0.9ppm. SO_2 to 1ppm. chlorine. Complete dechlorination is not necessary, and the dose of

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sulfur dioxide may be regulated to leave any desired residual.

Granular activated carbon is another satisfactory dechlorinating agent, and its use for this purpose has been thoroughly studied by Baylis (6). Most installations of carbon filters are of the pressure type, the granular carbon being supported by layers of gravel. These units may be operated with either upward or downward flow, though pressure units are usually operated with a downward flow. Carbon reacts with excess chlorine as follows:

$$2Cl_2 + C. + 2H_2O = 2HCl + CO_2$$

Pure carbon is theoretically capable of removing about 11.8 times its own weight of residual chlorine. Baylis has demonstrated that, since this is a direct chemical action, there is practically no limit to the amount of chlorine which might be removed from water by conversion to hydrochloric acid. Thus granular carbon units are able to dechlorinate water irrespective of how widely the residual chlorine content may vary, and to leave only a few hundredths parts per million in the finished water. According to the Behrman and Gustafson (8) the chemical reaction between chlorine and carbon is preceded by cumulative adsorption of the chlorine. Evidently a concentration of the applied chlorine in the pores of the carbon is necessary before the reaction productive of nascent oxygen can take place. A low pH value favors the reaction.

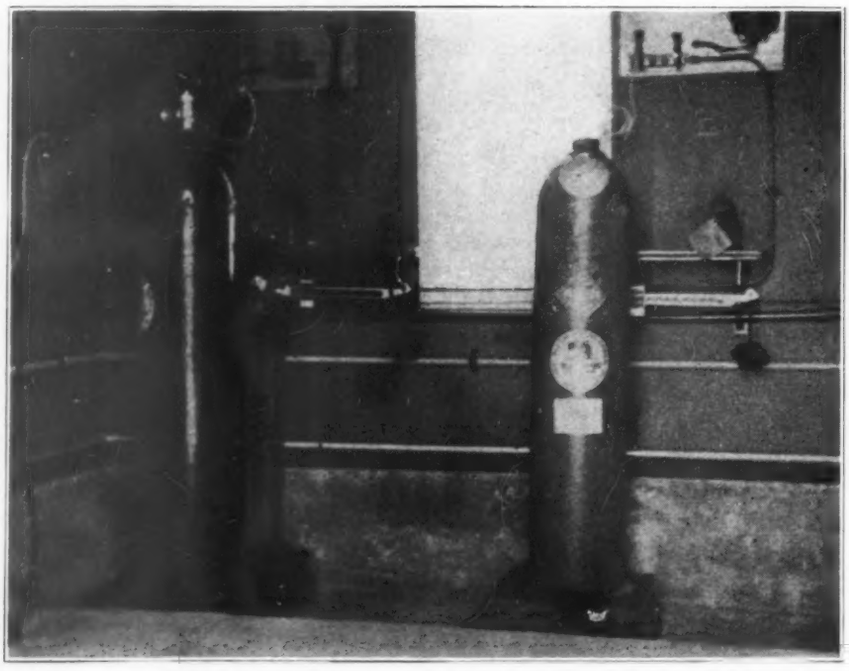
Sodium bisulfite has been in use for nine years as the dechlorinating agent at one plant. This material may be fed by means of a small dry feed machine but it has proved more satisfactory, at low rates of application, to dissolve the chemical and to feed it as a dilute solution. Sodium bisulfite is readily soluble and contains 65% available sulfur dioxide. Pflanz (9) reports that, in practice, the required ratio of anhydrous sodium bisulfite to residual chlorine is 1.6 to 1.0 for complete dechlorination is 1.6 to 1.0 chlorine.

Other chemicals can be used for dechlorinating but perhaps none is as economical as those in use at present. For experimental or temporary application, sodium thiosulfate (photographer's hypo) may be the most readily available dechlorinating agent. Its use for this purpose is described by Flentje (10). Considerable data on the use of Catarsit (essentially neutral calcium sulfite) as a filtering medium to remove residual chlorine has been made available by Adler (11). Bach (12) has proposed the use of a filter containing scrap magnesium metal for the removal of chlorine and carbon dioxide, but plant scale adoption of this process has never been reported.

Plants Employing the Process

A survey of those water treatment plants at which super- and dechlorination are employed as a part of the purification process supplies useful comparative data. It is apparent that the rules governing this practice are not rigid but, rather, that it may be adapted to function satisfactorily under a variety of different conditions. While there is wide diversity in methods of application, in type of tastes and odors, and in characteristics of the water treated, the process is successful in each case. In most instances the process is applied in conjunction with other purification methods.

At Toronto, two separate filtration plants are in use, one a slow sand filter employing no coagulant and one a mechanical filter plant using alum as the coagulant. The superchlorination dose is applied to filtered water in each plant and, after a contact period in the clear well, is delivered to a common pumping station where the mixed water is dechlorinated as it is pumped to the distribution system. Because of the longer contact period at the slow sand filtration plant and because this type of filter is more effective in partial taste removal, a lower chlorine dose has proved to be adequate at this plant. Superchlorination is not continuously required at these plants because of the variable occurrence of the taste problem. In 1938 this process was used during 189 days at the mechanical filtration plant and 192 days at the slow sand plant. An extension to the Toronto system, which will include a new 100 M.G.D. filtration plant of the rapid sand type, is under construction (13). Superchlorination following filtration and dechlorination after a minimum contact period of one hour and 20 minutes will be standard practice at this plant.



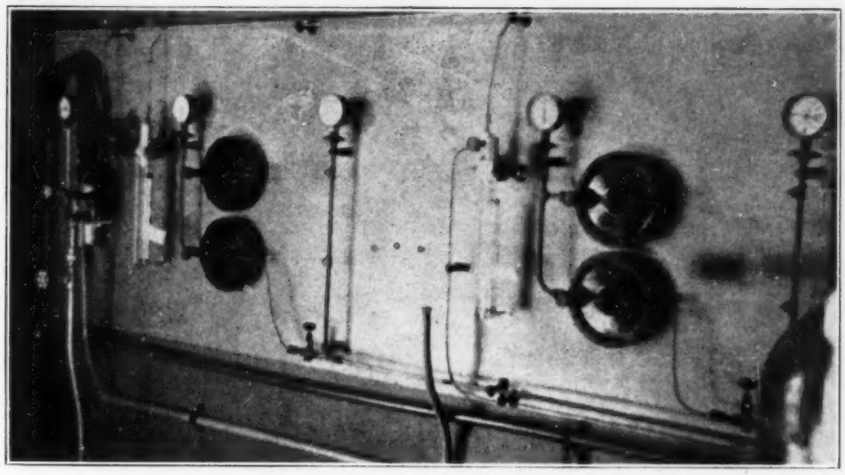
Chlorine and Sulfur Dioxide Cylinders on Scales

Well arranged installation in a small plant employing superchlorination and using sulfur dioxide for dechlorination.

At Glencoe, alum and the superchlorination dose are applied in the mixing basin. The chlorine residual is maintained through the settling basins, filters, and clear water well before dechlorination. With this long contact period, relatively low doses of chlorine have proved adequate (9). At South Fallsburg, N. Y., alum, soda ash, and the superchlorination dose are applied to the raw water. No coagulation or settling basins are provided, though it is realized that these would be desirable for improved operation (14). Filtration is through pressure type units and dechlorination takes place by a second filtration through a Permutit pressure filter containing granular (Nuchar) activated carbon.

Six plants in the vicinity of Los Angeles use a super- and dechlorination process for the treatment of well

waters, which contain hydrogen sulfide and iron and sulfur bacteria. The process is used with filtration, employing ferric chloride as the coagulant, at two plants. Two of the other four plants include aeration, and all have sedimentation basins to provide necessary contact time. Operation of all plants is almost entirely automatic (15). At five of the plants chlorine is applied in proportion to the raw water pumped, and sulfur dioxide is fed in proportion to the water sent to the distribution system. At one of the plants chlorination is automatic and dechlorination is accomplished by means of final pumping through International Filter type granular carbon units containing "Hydrodarco" carbon.



Panel for Automatic Chlorine and Sulfur Dioxide Feed

Actuated by electrically operated valves which are synchronized with pumps, this is a typical installation to feed superchlorination doses and to dechlorinate with sulfur dioxide.

It is reported that a number of large municipal installations in Europe employ Norit granular activated carbon in pressure filter units for dechlorination. These operate effectively at extremely high rates of flow and have been in use for several years.

Operating Data

Toronto (Mechanical Filtration Plant)

Super- and dechlorination started: 1926
Source of water: Lake Ontario
M.G. per day treated: Average 38.76 (Imperial)
Type of taste and odor: Largely phenolic
Point of chlorine application: Following filtration
Chlorine dose: 16 to 42 pounds per m.g. (Imperial)
Length of contact time: 60 minutes
Residual prior to dechlorinating: 0.7 to 2.0 p.p.m.
Dechlorination by means of: Sulfur dioxide
Point of dechlorination: Pumping station to distribution system.

Toronto (Slow Sand Plant)

Super- and dechlorination started: 1926
Source of water: Lake Ontario
M.G. per day treated: 35.36 (Imperial)
Type of taste and odor: Largely phenolic
Point of chlorine application: Following filtration
Chlorine dose: 14 to 28 pounds per m.g. (Imperial)
Length of contact time: 3.25 hours
Residual prior to dechlorinating: 0.7 to 2.0 p.p.m.
Dechlorination by means of: Sulfur dioxide
Point of dechlorination: Pumping station to distribution system

Glencoe, Ill.

Super- and dechlorination started: 1930
Source of water: Lake Michigan
M.G. per day treated: 1.0 aver. to 3.5 max.
Type of taste and odor: Fishy, muddy, musty, cucumber, aromatic; generally due to plankton
Point of chlorine application: Mixing basin
Chlorine dose: 8.0 to 30 pounds per m.g.
Length of contact time: Min. 3 hrs., aver. 12 hrs.
Residual prior to dechlorinating: Min. 0.8 p.p.m.
Dechlorination by means of: Sodium bisulfite
Point of dechlorination: Effluent of clear water well

Culver City, Calif. (Sentney Plant)

Super- and dechlorination started: 1933
Source of water: Wells
M.G. per day treated: 2.5 (plant capacity)
Type of taste and odor: Hydrogen sulfide, methane, those produced by iron and sulfur bacteria
Point of chlorine application: Following aeration
Chlorine dose: 25 to 42 pounds per m.g.
Length of contact time: Min. 4 hrs., Max. 6 hrs.
Residual prior to dechlorinating: 0.35 p.p.m.±
Dechlorination by means of: Granular activated carbon
Point of dechlorination: Following filtration

Venice, Calif. (Charnock Plant)

Super- and dechlorination started: 1933
Source of water: Wells
M.G. per day treated: 4.0 (plant capacity)
Type of taste and odor: Those produced by iron and sulfur bacteria
Point of chlorine application: Well water collection line
Chlorine dose: 20 to 40 pounds per m.g.
Length of contact time: Min. 1 hr., Max. 2 hrs.
Residual prior to dechlorinating: 0.35 p.p.m.±
Dechlorination by means of: Sulfur dioxide
Point of dechlorination: As pumped to distribution system

Lennox, Calif. (Truro Plant)

Super- and dechlorination started: 1934
Source of water: Wells
M.G. per day treated: 2.0 (plant capacity)
Type of taste and odor: Hydrogen sulfide and those produced by iron and sulfur bacteria
Point of chlorine application: Following aeration
Chlorine dose: 40 to 58 pounds per m.g.
Length of contact time: Min. 3 hrs., Max. 7 hrs.
Residual prior to dechlorinating: 0.35 p.p.m.±
Dechlorination by means of: Sulfur dioxide
Point of dechlorination: As pumped to distribution system

Culver City, Calif. (Sepulveda Plant)

Super- and dechlorination started: 1035
Source of water: Wells

M.G. per day treated: 1.5 (plant capacity)
Type of taste and odor: Those produced by iron and sulfur bacteria
Point of chlorine application: Well water collection line
Chlorine dose: 16 to 25 pounds per m.g.
Length of contact time: Min. 20 min., Max. 2 hrs.
Residual prior to dechlorinating: 0.35 p.p.m.±
Dechlorination by means of: Sulfur dioxide
Point of dechlorination: As pumped to distribution system

South Fallsburg, N. Y.

Super- and dechlorination started: 1936
Source of water: Surface supply, shallow lake
M.G. per day treated: Max. 0.2 (estimated)
Type of taste and odor: Algae, swampy, muddy
Point of chlorine application: Pump suction to filter
Chlorine dose: 16 to 50 pounds per m.g.
Length of contact time: Max. 10 min.
Residual prior to dechlorinating: 0.5 p.p.m.±
Dechlorination by means of: Granular activated carbon
Point of dechlorination: Following filtration

Lawndale, Calif. (Rosecrans Plant)

Super- and dechlorination started: 1937
Source of water: Wells
M.G. per day treated: 1.0 plant capacity
Type of taste and odor: Hydrogen sulfide, methane, those produced by iron and sulfur bacteria
Point of chlorine application: Following aeration
Chlorine dose: 8 to 16 pounds per m.g.
Length of contact time: Min. 2 hrs., Max. 4 hrs.
Residual prior to dechlorinating: 0.35 p.p.m.±
Dechlorination by means of: Sulfur dioxide
Point of dechlorination: As pumped to distribution system

South Los Angeles, Calif. (Normandy Plant)

Super- and dechlorination started: 1938
Source of water: Wells
M.G. per day treated: 1.0 (plant capacity)
Type of taste and odor: Hydrogen sulfide, those produced by iron and sulfur bacteria
Point of chlorine application: Following aeration
Chlorine dose: 20 to 25 pounds per m.g.
Length of contact time: 2 hrs.
Residual prior to dechlorinating: 0.35 p.p.m.±
Dechlorination by means of: Sulfur dioxide
Point of dechlorination: As pumped to elevated storage

Super- and Dechlorination for Temporary Conditions

There are a number of reported instances in which superchlorination followed by dechlorination has been applied for the correction of temporary taste and odor conditions. In 1929-30 Hale[16] successfully utilized such treatment for the destruction of a medicinal taste in water from shallow wells at Jamaica, N. Y. Despite the short contact period available and lack of technical supervision, this treatment proved to be very satisfactory in destroying the crenothryx which was at the seat of the trouble, flourishing and then decomposing in the mains. At Oklahoma City, Okla., when taste and odor troubles from algae are at the maximum during summer periods, Scott[17] has found superchlorination of raw water, followed by dechlorination, to be the practical method of control. The raw water is treated with high doses of chlorine and sulphur dioxide is applied by means of vacuum type W. & T. machines for dechlorination. Brown[18] has made a thorough study of methods for destroying growths of iron bacteria in water supplies. He reports superchlorination followed by dechlorination to be the most satisfactory method, and describes the use of this process in one reservoir.

It is probable that a much wider use has been made of super- and dechlorination than is revealed by published accounts, if we may judge from scattered reports lacking in data sufficient to warrant publication.

Superchlorination Without Dechlorination

There are many conditions under which it may be possible to apply superchlorination doses and to so reduce the remaining residual chlorine that application of a dechlorinating agent as such becomes unnecessary. The most simple of such methods would, of course, be to allow the treated water to stand for a long period of time. If water is exposed to sunlight the loss of chlorine is particularly rapid, due to photochemical action. Just such a method has been in successful use for over one year by Lloyd[19] at Tyler, Texas. He has learned that the maintenance of a chlorine residual of 0.8 to 1.0 p.p.m. in coagulated and settled water, as applied to filters, adequately controls tastes and odors. Treatment includes aeration, coagulation with alum, and the use of lime for pH adjustment. Residual chlorine in the distribution system after dissipation in the reservoir, providing 4 hours of contact, varies from 0.1 to 0.3 p.p.m.

Tyler, Texas

Superchlorination treatment started: April, 1938.
Source of water: Shallow lake.
M.G. per day treated: Approx. 1.0.
Type of taste and odor: Algae and decomposing vegetation.
Point of chlorine application: Mixing basin.
Chlorine dose: Max. 16 pounds per m.g. in winter; 58 pounds in summer.
Length of contact time: Approximately 4 hrs.
Residual prior to filtration: 0.8 to 1.0 p.p.m.
Dechlorination: None (natural loss of residual).
Residual in distribution system: 0.1 to 0.3 p.p.m.

Under other conditions, there may be such a relatively low chlorine residual remaining, after superchlorination and contact, that the addition of ammonia as the water enters the distribution system would adequately control the true chlorinous tastes. Considering residuals remaining in the water before dechlorination at those plants which now employ superchlorination, it would appear that frequently only the addition of ammonia might be required to produce a satisfactory water. If a chlorine to ammonia ratio of 2 or 3 to 1 proved suitable for this purpose, the use of ammonia would be no higher in cost than sulphur dioxide, and would at the same time result in carrying a longer persisting residual into the distribution system. [In regard to this suggestion Mr. Faber and his audience will find interesting reading in another article in this issue by R. G. Yaxley of Waterford, N. Y.—ED.]

It should be possible to dechlorinate with copperas (ferrous sulphate) when using copperas and lime for coagulation. The residual chlorine, after superchlorination, would partially oxidize the ferrous iron and assist subsequent flocculation with lime.

At Pittsburg, Calif., Cook[20] has utilized a combination of aeration and superchlorination to destroy tastes and odors due to hydrogen sulphide and the dose is adjusted so that, in combination with aeration, both iron and hydrogen sulphide are precipitated. By carrying some excess chlorine on to the filters, the precipitated iron is not redissolved and is utilized as the coagulant. Cox[21] reports a similar removal of residual hydrogen sulphide, after aeration, at Holland, N. Y.

Experiences with the effective use of chlorine for control and destruction of algae have been frequently reported. Usually the required dosage was higher than that required for disinfection, but not so high as to require dechlorination. Details of such treatment have been published by Brush[22], Cohen[23], Bakke [24], Mangum[25], and the literature contains a rather complete summary of this practice by Hale[26].

Industrial Use of Super- and Dechlorination

High doses of chlorine, sufficient to produce a residual of 3.0 to 4.0 p.p.m. before filtration are used[27] industrially for treatment of process water employed in food and beverage production. The International Filter Company has made several hundred installations of this type. They involve heavy prechlorination, either lime softening or coagulation and sedimentation, followed by pressure sand filters with final dechlorination by means of a pressure filter unit containing granular Hydrodarco activated carbon. Chlorine is fed, in conjunction with other treating chemicals, in the form of hypochlorite and a minimum contact period of 2 hours is provided. Ordinarily a 20-inch deep bed of the activated carbon gives a rated capacity of 2 gal. per sq. ft. per min., and with a 30-inch depth of bed the rate is increased to 3 gallons. In these installations sterile water, free from tastes and odors, is delivered without the requirement of close chemical control. The treatment has proven very satisfactory in carbonated beverage plants, ice plants, and food processing plants. A large number of similar units have been installed[28] by the Permutit Company. These operate at the same rates and provide dechlorination by means of pressure activated carbon filter units containing granular Nuchar. Both the completeness of such a treatment process and the simplicity of control have been responsible for its widespread adoption.

What Constitutes Superchlorination?

Houston[2] appears to have derived the term superchlorination from his reference to the use of "superdoses" of chlorine. The process has been defined[21] as: "The use of such high doses as to require the subsequent use of a dechlorinating agent." This is, perhaps, the generally accepted understanding of the superchlorination process. But, according to such a definition, a dose of chlorine sufficiently high to require dechlorination may be applied to water and yet may produce no oxidation. The dose may serve only to intensify the tastes and odors, leading to the conclusion that the process is unsatisfactory or not applicable to the particular water.

The fallacy of determining the efficiency of disinfection by the number of parts per million chlorine added has long been recognized. It has been learned that the proper criterion of disinfection is the measurement of residual chlorine after a definite contact period. In the same manner, the addition of doses of chlorine well in excess of demand are no indication that adequate oxidation of organic matter will follow. The proper procedure to determine the effectiveness of a superchlorination dose may again be to utilize a definite residual of chlorine after a definite period of contact. Just as a chlorine dose which is adequate for the disinfection of one water will prove inadequate in a different water, a superchlorination dose for one water will not be a truly effective superchlorination dose in a different water. For instance, the pH value of the water and probably its ammonia content, may have much to do with the effects attained from excess chlorine.

A number of authors have demonstrated that the dose of chlorine required for oxidation of tastes and odors will depends not only upon the type and intensity of those tastes and odors, but upon the length of contact time and upon the temperature of the water. The dose of chlorine will vary in some inverse relation to the length of contact time. The reaction proceeds with greater rapidity as the temperature of the water increases. It will be noted that the chlorine dose which, apparently, produces adequate oxidation in those plants which have used a superchlorination process for a period of years varies from a minimum of 8 pounds to a maximum of 60 pounds per million gallons. The other important factor, contact time, is shown to range from 10 minutes to 12 hours.

It is recommended by Baylis[6] that application of chlorine for the superchlorination process be made, wherever possible, to water in the mixing basin in order to provide the maximum contact time. Sometimes it is not possible to do this because the residual applied to filters will react with organic matter which has accumulated in the filter beds and produce objectionable chlorosubstitution products. In most instances this difficulty will be of short duration at the beginning of the process and should not reoccur if the treatment is continued. He experienced no trouble with filter beds increasing the taste in water at the Chicago Experimental Filtration Plant by the continuous use of the superchlorination treatment, but these were assumedly clean beds resulting from good supervision and effective bed washing methods.

Howard[4] reports laboratory experiments which show the intensity of taste in Toronto water to increase gradually with corresponding increases in the dose of chlorine. After a maximum taste is produced and the dose of chlorine is *further* increased, nothing is apparent but a strong chlorine taste. Upon dechlorinating the samples, those which had received sufficiently high doses to taste only of chlorine were found to be entirely without taste. Those samples receiving lower doses of chlorine still possessed the objectionable taste. The series of experiments is illustrated graphically in Fig. I.

A set of experiments by Harrison[29] gives data on the production of tastes when increasing doses of chlorine are added to a solution containing 0.075 p.p.m. of phenol. Chlorophenol tastes made their appearance with 0.125 p.p.m. of chlorine, disappeared at 0.5 p.p.m., reappeared with 0.8 p.p.m. and disappeared entirely at 1.0 p.p.m. Any further increase in chlorine had no effect and no tastes reappeared after standing for 24 hours. The results of these experiments is shown graphically in Figure II. He also presents laboratory data showing that waste from gas works and waste from wood distillation plants (each diluted 1:10,000) could be rendered tasteless by the addition of 1.2 p.p.m. and 1.0 p.p.m. chlorine, respectively. Following these experiments, Harrison[30] tried superchlorination on a plant scale, applying doses of 2.69 p.p.m. for about three months and for two days a maximum dose of

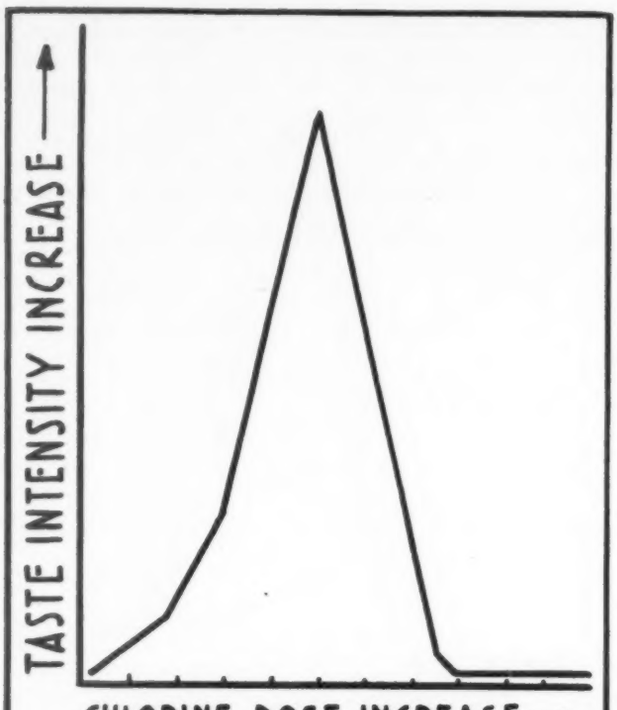


FIG. I HOWARD: CHLOROPHENOL TASTE FORMATION AT TORONTO

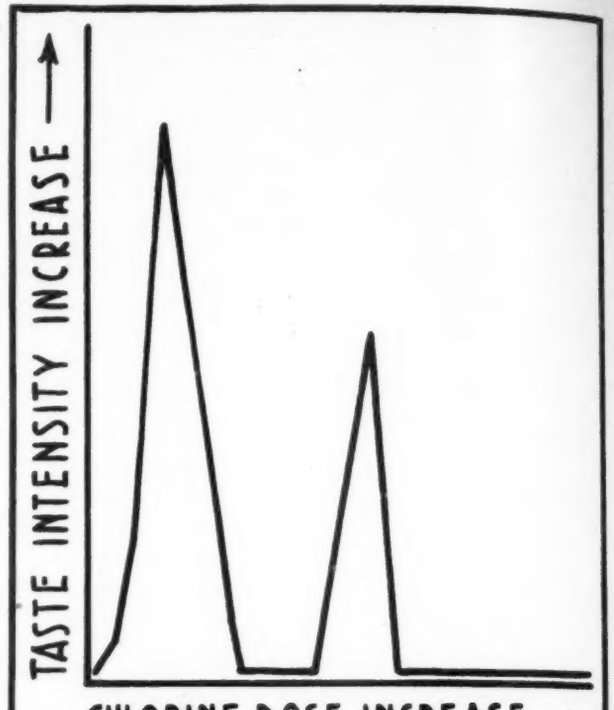


FIG. II HARRISON: CHLOROPHENOL TASTE FORMATION AT BAY CITY

3.88 p.p.m. The results were highly disappointing since, in addition to intensified chlorophenol tastes, nauseating side tastes were experienced. Despite evidence from laboratory tests that the typical tastes could be oxidized with an adequate dose of chlorine it appears that a sufficiently high dose was not applied in the plant scale tests. This is apparent from a statement that the organic content of this water increases during taste periods. A second reason for the failure of this process on a plant scale is likely due to the fact that the chlorine was applied to the raw water and the sulphur dioxide, used for dechlorination, was not applied until passage of the chlorinated water through the filters. Since the filter beds contained additional organic and phenolic material, it seems entirely probable that the residual chlorine passing through the filters was inadequate for oxidizing this additional material and acted to form tastes more intense than before. This is apparently an instance of high chlorination improperly termed superchlorination. Furthermore, the probability is that the films on the sand grains were loosened and vitiated the effluent.

Billings[31] at Grand Rapids, Mich., reported the application of a high chlorine dose, applying up to 2 p.p.m to the surface of five filters which were producing a taste in the water. The chlorinous tastes were said to increase in proportion to the amount of chlorine fed. Obviously the term superchlorination was improperly applied when considering the dose and conditions described at this plant. Gibbons[32] describes the plant scale use at Rahway, N. J., of chlorine doses from 1.0 to 2.6 p.p.m. with a contact period of two hours, at intervals for a total of over 200 days. Marked medicinal, woody, and chemical tastes were present in the water and varied widely in concentration from day to day. When chemical pollution of the raw water supply was not excessive, the higher dosage of chlorine aided in preventing a medicinal taste in the supply, but in general there was little benefit. Again it is apparent that the dose of chlorine applied was insufficient to accomplish oxidation in such a heavily polluted water.

Cox[33] found in laboratory studies that chlorophenol tastes in water at Buffalo, N. Y., could be destroyed by chlorine doses of 1.0 to 2.5 p.p.m. and that the water had no chlorophenol taste when dechlorinated. Plant facilities did not permit full scale application of the process.

Determination of the Superchlorination Dose

It has appeared desirable that a method be developed which will effectually determine the dose of chlorine which will insure oxidation of tastes and odors. When gradual increments of chlorine are added to a series of water samples, it has been found, as would be expected, that the amount of absorbed chlorine increased with increased doses. But the rate of absorption or reaction of the chlorine is *not* directly proportional to the dose in any water which has been tested. Instead, the residual changes in an erratic curve as shown in Fig. III. It is believed that an increase in the rate of residual absorption or chlorine reaction is due to the oxidation of various substances occurring at different chlorine concentrations or potentials. In highly polluted waters it has been found that the chlorine *residual may actually be materially less after higher doses of chlorine than is found to exist with lower doses.* This condition is illustrated in Fig. IV. Instances have even been found in which the chlorine residual, after adding a high dose, will become but a trace too small to measure

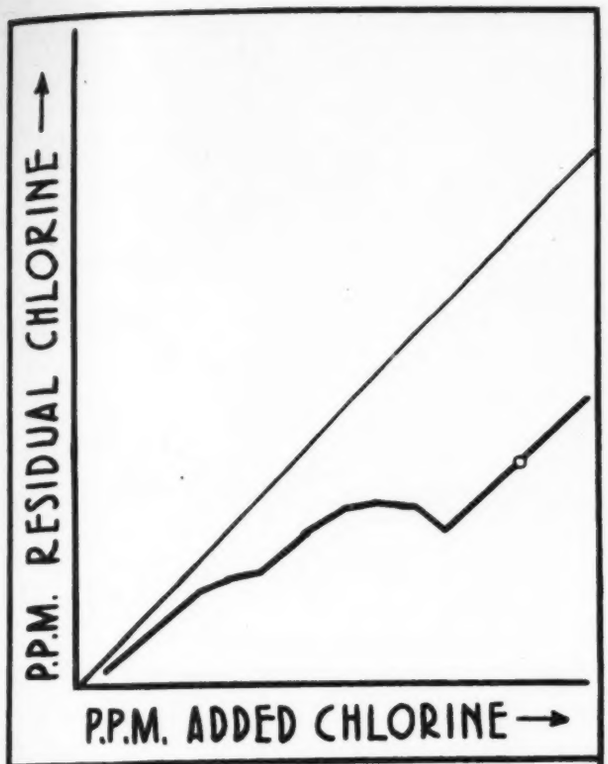


FIG. III TYPICAL CHLORINE RESIDUALS WITH HIGH DOSES

if not actually zero. Therefore, it appears that a distinction must be made between the chlorine "disinfection" demand of water and the chlorine "oxidation" demand of a water.

When Is Oxidation Complete?

It is proposed that such a series of samples be run on a given water when it is desired to determine the effect of superchlorination. In all the waters so far tested, oxidation of tastes and odors has been found complete *only when the residual curves for a series of samples rises progressively with progressive increases in added chlorine.* Since there may be several points on the residual curve at which the same residual will be found, but at which it is apparent the degree of reaction or oxidation is different, the safest procedure will be to select that point so high on the curve (Figs. III and IV) that above it only higher residuals exist. It is probable that this residual would insure complete oxidation at all times. Such a point is illustrated by the dot on each of the two typical curves shown.

Disinfection by Superchlorination

It is almost unnecessary to indicate that higher doses of chlorine are most effective in accomplishing greater bacterial kills. Low chlorine doses produce the greatest amount of disinfection per pound of chlorine, but the more resistant types of microorganisms often remain viable and may be unaffected until an oxidizing dose of chlorine is added. If superchlorination can thus reduce the bacterial load in filtration plants and can insure the production of water of a high degree of bacterial purity in addition to the destruction of tastes and odors, the bacterial result is a secondary advantage of very real importance.

Baylis[84] found in laboratory studies that the 37 deg. count of a sewage plant effluent which contained from 6,700 to 20,000 bacteria per cc could be reduced to zero per cc, using a process of superchlorination followed by dechlorination. Under actual operating conditions at the Toronto plants, Howard reports the following results, which illustrate the effectiveness of this process on a highly polluted water:

TORONTO FILTRATION PLANTS
Average Bacteriological Results for 1938

Note: Water is superchlorinated after filtration at each plant but mixes before dechlorination. Quality of the finished water is, therefore, of the mixture.)

	Total Colonies per cc, 37°C.		Coli-Aerogenes, per cc, 37°C.	
	Raw Water	Finished Water	Raw Water	Finished Water
Mechanical Filter Plant	1861	0.72	81.32	0.00017
Slow Sand Filter Plant	4071	0.72	106.69	0.00017

Summary

The superchlorination process has been demonstrated, at those water treatment plants where it has been standard operating practice for a period of years, to be an effective means of taste and odor control. The destruction of tastes and odors due to algae, decaying vegetation, phenols, hydrogen sulphide, iron and sulphur bacteria, is entirely possible. The doses of chlorine required for this purpose are not excessive when compared with the cost of other methods of taste and odor removal. Under some conditions the cost of taste and odor removal by the process may even be less. Many

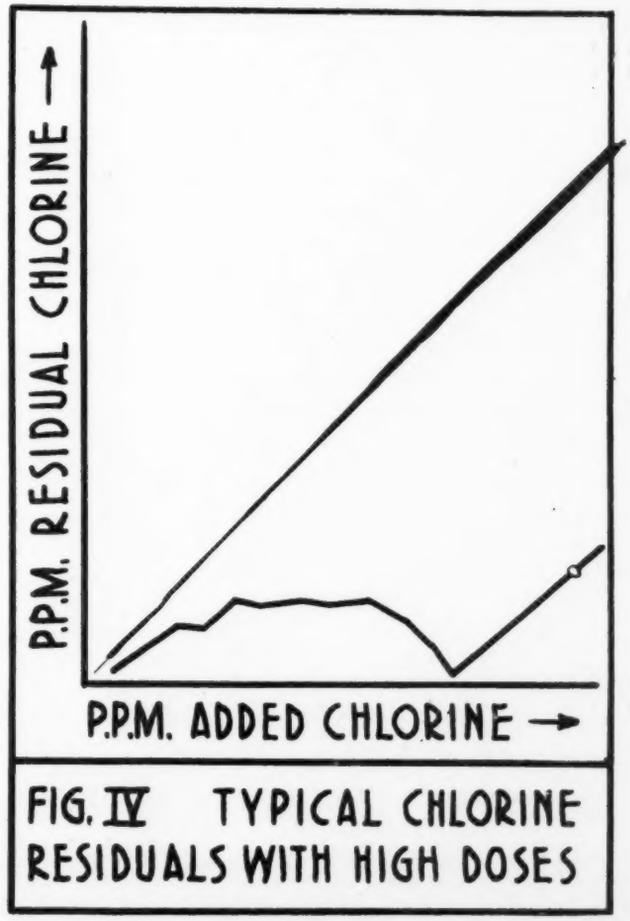
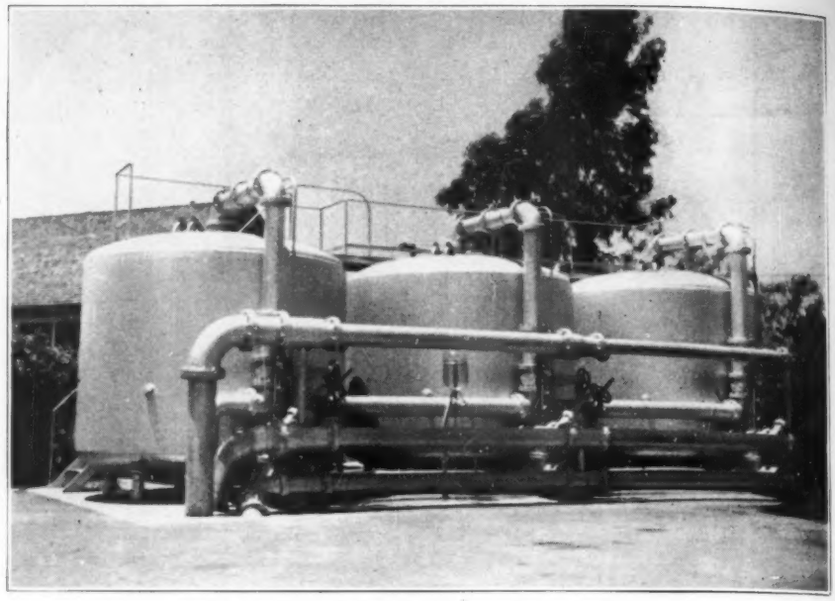


FIG. IV TYPICAL CHLORINE RESIDUALS WITH HIGH DOSES

plants using relatively high doses of chlorine for disinfection are approaching superchlorination doses and need relatively little increase to make it effective. It may be found that the cost of additional chlorine required to accomplish oxidation would provide the most economical means of taste and odor control. Both sulphur dioxide and granular activated carbon have proven to be economical dechlorinating agents. Both methods are applicable to plants of any size and may be made practically automatic in operation. A secondary advantage of using superchlorination is the high degree of bactericidal efficiency of such a process. This, too, has been demonstrated by both laboratory and plant results. In certain instances where the process has been tried without success, explanation of possible reasons for this condition are advanced. A method is proposed for laboratory control which will indicate the degree of residual necessary to assure oxidation of a given water at a given time. It is suggested that the consistent use of this method to control plant operation will indicate the dose of chlorine necessary to accomplish effective superchlorination under varying conditions.



Granular Carbon Filters for Dechlorination

These pressure filter units operate at high rates and remove all but small traces of residual chlorine. Gravity filters may also be used, but either type must be preceeded by sand filtration to insure long life of the carbon.

Acknowledgement—The author desires to give full credit to those who have so generously contributed the necessary data concerning superchlorination and dechlorination practice, and in particular to: L. J. Alexander, Southern California Water Co.; J. R. Baylis, Experimental Filtration Plant, Chicago; O. A. DeCelle, International Filter Co.; N. J. Howard, Toronto, Canada; J. M. Lloyd, Tyler, Texas; E. L. Pflanz, Glencoe, Illinois; and E. P. Schiman, Permutit Company.

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"TASCHENBUCH der STADTENTWASSERUNG"

By KARL IMHOFF

(A Review by C. E. KEEFER*)

Taschenbuch der Stadtentwässerung (Handbook of Municipal Drainage) by K. Imhoff. 252 pp. Published by R. Oldenbourg, Munich, Germany. Price 6½ marks.

With his usual clarity and brevity Dr. Imhoff brings to his readers up-to-date information regarding the design of sewage-treatment plants and sewerage systems. That the book has been popular among German engineers is evidenced by the fact that it has gone through eight editions.

The book is divided into two parts. The first part, which deals with the design of sewers and drains, covers forty-six pages; the remainder of the book relates to the treatment of sewage. In the first section there are several tables and diagrams that are useful in designing sewers. The hydraulic elements of a number of conduits with a variety of cross sections are given.

It is with that portion of the book devoted to sewage treatment that American readers will probably be most interested. In this section Dr. Imhoff includes much of the more recently published information on sewage treatment. For example, mention is made of the use of chlorine and air for the removal of grease from sewage in grease-separation tanks; high-rate trickling filters are discussed; and the treatment of sludge by the elutriation process prior to dewatering on vacuum filters is referred to. Reference is also made to the heat drying and the incineration of sludge.

One of the valuable features of the book consists of the solution of problems, which indicates the procedure to follow in determining the sizes of various types of treatment units. The last chapter contains an excellent discussion of the self-purification of water with diagrams and illustrative examples. It is interesting to note that Dr. Imhoff includes in his book a table prepared by Prof. Fair and recently published (Sewage Works Journal, May, 1939) for solving problems involved in the pollution and the self-purification of diluting waters. Of value to the American engineer who has to refer to German publications is the inclusion of a table giving the relationship between American and German units of measure.

The book is well-printed and attractively bound, and the cuts and diagrams have been appropriately selected and carefully prepared. As its name implies, the book is of such a size that it can be carried in one's pocket. For the engineer who desires up-to-date information on sewerage problems presented in a concise manner, and who does not have the time or the inclination to refer to more extensive treatises, the book should be of special interest.

In the preface Dr. Imhoff states that a new book on sewage treatment, prepared by himself and Prof. Fair and based on the German publication, will shortly be available for American readers. If this forthcoming book is anything like its German prototype, it should be of interest and value to designers of sewage plants.

*Bureau of Sewers, Baltimore, Md.

LET'S GO!

Dear "Bill"'

Our mutual friend, "Doc" Taylor, Water Supt., at Roanoke, Va., had what seemed to us, a very happy idea when he started his series of short and interesting "How We Do It" articles which took the form of an informal open letter to every "Bill" who reads WATER WORKS & SEWERAGE.

It was his (and our) suggestion that some of the "Bills" reciprocate by a "reply" for publication —a sort of "Round Table by Letter" idea, which sounded pretty good.

In a recent issue "Hank" Hotchkiss of Larchmont, N. Y., had an interesting letter to "Tom." And, on another page in this issue is a *most* interesting open letter from "Bob" Yaxley of Watertown, N. Y., who writes "Jim" what "Pete" is doing at his plant. It's a *swell* "letter"—be sure to read it. It's a "believe it, or not" story, and a good one.

Now that the old ball has really started rolling, "Doc" Taylor feels mighty good about his original idea (who by the way has a splendid article starting in this issue), and *we* feel mighty good about it too.

So, "Bill," if you've "been thinking you might" just get past that thinking stage and take your trusty pen in hand. Let us have the letter, (and a picture or two if you can get them), and we will do the polishing up stuff at this end. Ideas are what we need—the editing is just a lead pipe cinch.

Yours for more "Dear Bill" letters,

—Ed.

LEAKS VS. TAX PAYERS DOLLARS

By ERNEST A. MERRITHEW
Supt. Public Works
SAUGUS, MASS.

TO THE average man, figures and charts are uninteresting. However, when those figures and charts indicate a loss or a saving to the overburdened taxpayer, they assume a more personal significance to those of us who are in charge of municipal utilities.

The following chart demonstrates what careful and periodical inspection of water mains will do for the property owners of a town. In this case the Town of Saugus, Mass., actually purchases water wholesale for distribution, some being pumped.

	Cost of Water Purchased	Cost of Power for Pumping
1936	$22,634.00	$1,810.00
1937	19,855.00	1,389.00
1938	17,509.00	1,105.00

The above figures show a total saving over a two-year period, including an estimated $1000 for labor at the pumping station, of $10,230. If that is the experience of one town of 16,000 population, what must be the cost of water losses each year if we consider the entire country?

Our Experience in Curtailing Waste—

The Town of Saugus, Massachusetts, has about 48 miles of water mains. The original low pressure system was not capable of supplying water in reasonable quantities or pressures to the higher elevations as they were developed. In order to supply those sections a high pressure line was installed which drew its supply from a standpipe erected for the purpose.

Of the total of 48 miles of main pipe, the low pressure system includes some 9 miles of old-fashioned concrete pipe which varies in size from 4 to 16 inches. The remainder of the low pressure system and the entire high pressure system is of cast iron.

In 1936 the writer—then the new superintendent of Public Works, believed that something should be done to reduce the water losses in Saugus, and a course of action was decided upon.

A copy of a Pitometer survey, admittedly somewhat old, was consulted, and a section of the main system was chosen in which to begin the work.

The Author

Six hours after the work was begun, a large leak was located on one of the higher elevations of the town. For years several of the homes in the neighborhood had been troubled with damp cellars, but nothing had been done about it.

Pressures were checked at the various hydrants in the vicinity. From this check the leak was determined to be on a certain street. Men were then sent into the various homes to listen for the sound of running water. This narrowed the location of the leak down to a small area. A series of test holes were dug along the location of the main until the leak was discovered.

The Pitometer Was Right!

Here's what we found when we dug in. This boulder dodging dog-leg construction picture might be captioned "How Not to Lay a Pipe Line." In leakage, poor construction has cost Saugus rate-payers many a penny.

It proved to be a joint leak from which all traces of lead and jute had disappeared. Faulty workmanship was probably the underlying cause of this leak.

Because of the rocky nature of the terrain in that particular neighborhood no sign of water ever appeared on the surface of the road.

A rather amusing incident connected with this particular leak was the disappearance of a beautiful spring some distance away, from which great quantities of crystal clear water flowed for twenty-four hours each day. The owner of the property upon which the spring was situated had taken a great pride in his spring and had found it indispensable when watering his garden that grew about the spring.

The repair of the leak not only caused the disappearance of the spring and dried up the neighboring cellars, but the pressure over the entire section was increased by six pounds.

Leakage Surveys Now Routine—

Other leaks in our low pressure system have been located and eliminated through the medium of thorough inspections of all services by the meter readers at the time of their regular semi-annual readings. Systematic, semi-annual inspection of all hydrant pressures have also been the means by which we have found several other large leaks.

Pressure checks are also made by men of the department at specified hydrants between the hours of 1:30 a. m. and 5:30 a. m., at which time consumption is the lowest.

The same measures for locating leaks have been applied to both the high and the low pressure systems. In every instance, leaks in the high pressure system, which consists entirely of cast iron pipe, have been assigned to faulty workmanship.

Results—

The results of eliminating leaks in our high pressure system have been the reduction in pumping hours from as many as 10½ to as few as 2¼ hours per day. In addition, the cost of power at the pumping station has been reduced approximately $700 per year and labor at the station about $500 per year.

During the past two years our total consumption has been reduced by 75,000,000 gallons per year. In 1937 and and 1938 this decrease, due to the elimination of a number of leaks, has netted the Town of Saugus approximately $10,320, or about 80c per $1000 of valuation.

Our system is still far from being 100% free of leaks, but we are satisfied that considerable progress has been made during the past two years toward eliminating the leakage problem. We have recommended that a new Pitometer survey be made, but because of the present high taxes, have little hope that such a project will be approved this year. We plan also to replace the old cement main with cast iron at the earliest opportunity.

Experience has proven to us, that in our own case at least, loss of water through leakage, with its resultant loss in dollars to the taxpayers can only be controlled through constant vigilance and real co-operation by all members of a department; regular semi-annual inspections at all points by means of pressure readings at the hydrants; inspections by the meter readers at the time of their regular readings; and checking pressure gauges at the office, fire station and the pumping station.

NEW ENGLAND BOASTS SOMETHING NEW IN WATER TANKS

Unique 1,660,000 Gal. Reservoir at Brookline, Mass.

AS FAR as we know the unique Hortonspheroid tank, designed for liquid storage, has never before been utilized for storage of public water supply until the unit here pictured was fabricated and erected for the City of Brookline, Mass.

The Hortonspheroid, named for its designer George T. Horton, president of the Chicago Bridge and Iron Co., was originally designed for storage of light oils and gasoline, for which purpose many have been erected in the oil fields.

There is a reason for its unique shape. (If it were red those passing in a plane might take it for a giant tomato. Instead, with its silvered surface of aluminum paint, it looks like a large globule of shining mercury.)

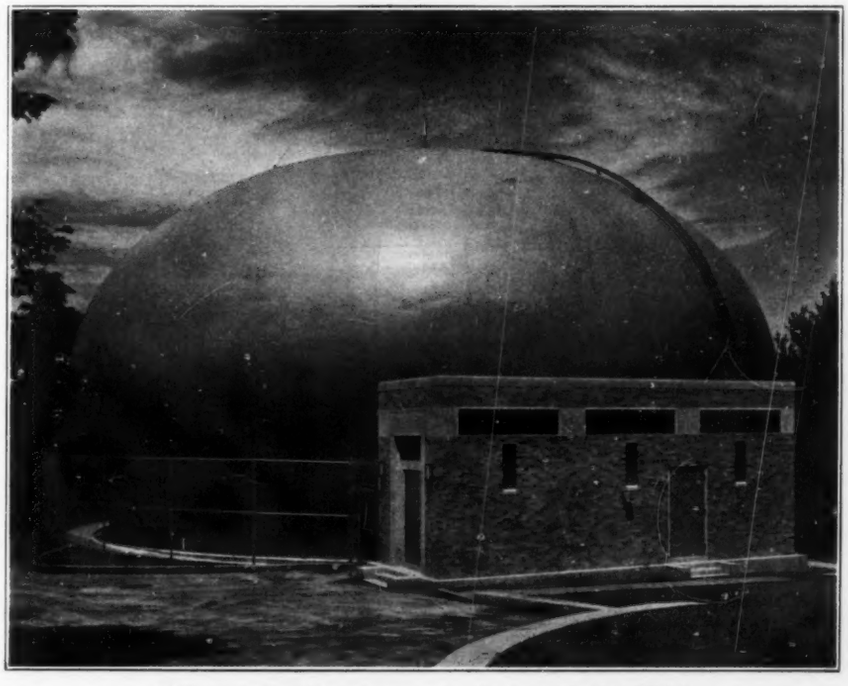
The shape and ratio of dimensions of Horton's novel spheroidal design is that decreed by Mother Nature—we refer to natural gravity. If you take a thin walled rubber ball, for instance, and about 75% fill it with a liquid and allow it to rest on a level surface, the shape of Horton's spheroidal tank is the natural result. So in the design, where stability and wall strength is most needed to meet gravity's demands or internal pressures, strength is supplied in the structure. Result, a natural distribution of wall thickness and flexure tolerance and an economic utilization of materials.

So much for the answer to the question "Why the Shape?"

The reasons, however, for the selection of this design by the Brookline authorities was almost entirely that of appearance and the low range of head. There is a municipal regulation limiting the height of structures in this particular high value residential area and the spheroidal shape appealed on the grounds of appearance as well as utility. It hardly looks its 90 ft. diameter at its spring-line, nor its 47 ft. water depth bottom to the high water line. Its capacity, however, is 1,660,000 gallons.

Of welded construction throughout, the bottom plates are ⅜" thick; the course adjacent to the bottom are 13/32" thick, while the ring just above the brackets is of 5/16" plates. The next two rings and the top are ¼" plates. All plates are pickled by Chicago Bridge and Iron Company's phosphoric acid corrosion suppression process, before shipment for erection. After erection the edges of the plates and scuffed portions were touched up and the entire structure given a final coat.

(In a coming article this effective process of pickling by the protective film-forming phosphoric acid process will be described by Milo E. Smith of the Chicago Bridge and Iron Co.—Ed.)



Hortonspheroid is News in Water Works Field

DE-WATERING MAINS WITH COMPRESSED AIR

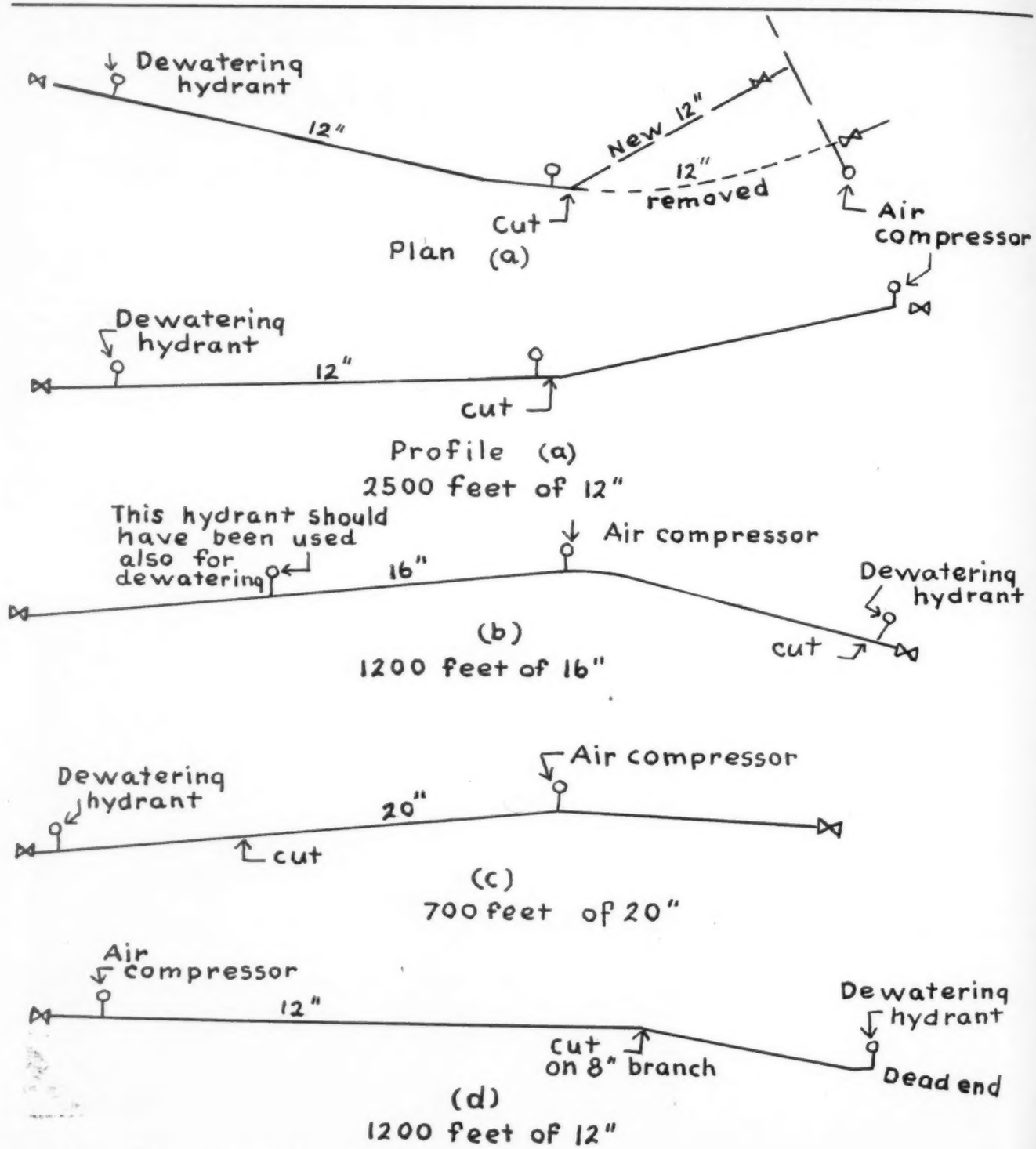
By ARTHUR C. KING, Supt.
Taunton Water Works
TAUNTON, MASSACHUSETTS

The Author

SOME time ago there appeared in "WATER WORKS AND SEWERAGE" an article by Roger W. Esty and Nelson Boardman of Danvers, Mass., describing the use of compressed air for removing water from mains.*

Here in Taunton, Mass., we have adopted the method, developed by Messrs. Esty and Boardman, and

*Also reproduced in the 1939 Reference and Data Issue of this magazine.



have successfully used it on pipe of such size that we believe our experience might be of interest to others who may have questioned the value of the scheme for mains of larger sizes.

An Experience With a 12-Inch Main

Owing to new building construction at the State Hospital here it became necessary to relocate about 600 feet of 12″ cast iron main within Hospital property. Some occupied buildings were supplied from the section to be relocated. It was therefore decided to lay a main in the new location before cutting off the old, and to salvage the old pipe afterwards.

After the new pipe was laid, the problem was that of making the connections between the old and new as quickly as possible, both on account of regular use and also the reduction in fire protection during the change-over. The section to be drained (about 2500 ft.), lay on an up-grade, as will be seen on the accompanying sketch (a), and hydrants were already in place at the high end and near the low end. The main was shut down, the hydrant near the low end was opened, and the air compressor connected to the hydrant *at the high end*. In a surprisingly short time, perhaps 40 minutes, although it was not timed, water ceased to come out of the hydrant and the main was cut. No water came out through the cut. The old and new sections were connected and the water turned into part of the new main within 4 hours, restoring service to all buildings. The upper end was then cut off and reconnected. Not a bit of ditch pumping was required and the results seemed remarkable.

We Try a 16-inch Main

Another large main we de-watered with compressed air was of 16″ cast iron. The length between gates was about 1200 feet—see sketch (b). About 800 feet was on a slight upgrade to a summit where there was a hydrant, and the other 400 feet was on a downgrade to the point of cutting, with a hydrant in that shutdown section just beyond the cut. The low hydrant was opened and the compressor connected to the hydrant at the summit. The water was quickly driven out and the cut made. In this case, apparently some gate was not shut quite tight as a trickle of water occasionally came out, but it was not enough to make trouble for us. We considered this job also a remarkable demonstration of the Danvers method.

On second thought, another hydrant might have been opened to dewater part of the main on the slope back from the summit on the other side from the work, before the cut was made. Then any leakage in that section could have accumulated in the empty main without going over the summit.

We Do a 20-inch Job

On another occasion we used the air to empty about 700 feet of 20″ cast iron pipe, sketch (c). The upper end was nearly level for about 200 feet then the pipe sloped down from a hydrant at the summit about 500 feet past the work to be done to a hydrant at the low end. Here again no difficulty was experienced and the water was driven out very quickly, but was not timed.

We also drained about 1200 feet of 12″ cast iron shown on sketch (d). In this case we cut out and replaced an 8″ gate valve on a branch main a few feet away, and on an up-grade, from the 12″ main. The whole job of de-watering, cutting out the old and inserting the new gate, was completed in less than 2 hours.

Our compressor is set for a maximum of 95 pounds pressure and starts up when the pressure drops about 10 pounds. We did not note what pressure was held during dewatering, but there was no indication of lack of air or pressure for these lengths of 12″, 16″ and 20″ mains. The rated capacity of our compressor is 110 cubic feet per minute.

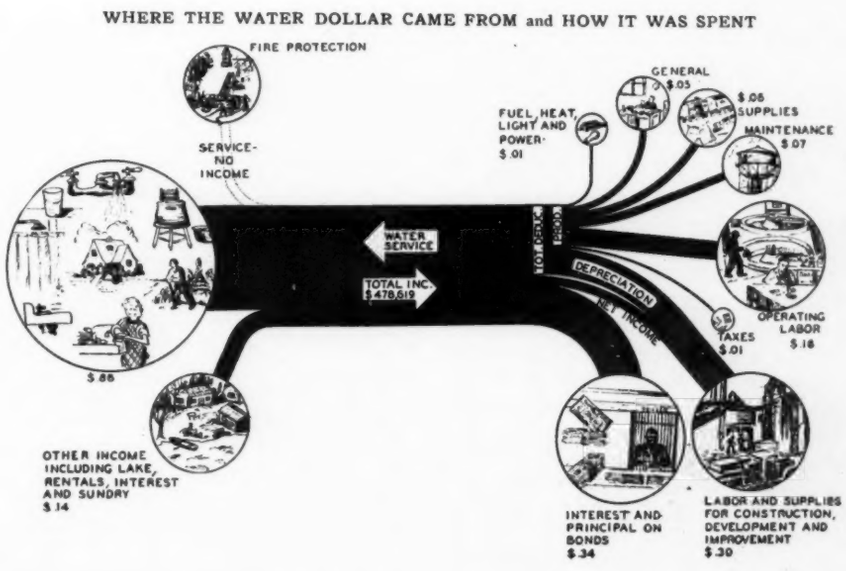
Needless to say we are quite sold on this quick and easy method of de-watering mains—both small and large—and are pleased to tell readers of "Water Works and Sewerage" of our experiences.

THAT THE PUBLIC MAY KNOW

The most interesting method of showing water consumers and the taxpayers of Springfield, Ill., "Where the Water Department Dollar Comes From *and* How Spent" was used by W. J. Spaulding, Commissioner of Public Works, in popularizing the 21st Annual Report of Springfield's Water, Light and Power Department.

The Chinese adage that "one picture is worth 10,000 words" is certainly proven in this instance. To one and all, this sort of presentation is at once understandable, interesting and impressive.

To water works men it is of considerable interest that the Springfield Water Department receives no income in the nature of hydrant rentals, but none the less pays taxes. Further, that income from lake (reservoir) recreational concessions from rentals and the like, pays all bills for chemicals and other supplies purchased, plus the cost of maintenance and fuel, light and heat, on the production end of the system—namely, for softening and filtration.



THE SEWAGE TREATMENT PLANT OF LAKEWOOD, OHIO

As Modernized and Enlarged, Represents the Third "Generation" of Plants

By ROLLIN F. MAC DOWELL
Consulting Engineer
CLEVELAND, OHIO

The Author

THE City of Lakewood, Ohio, is now completing the construction of improvements to its sewage treatment plant, the purpose of which is to increase its capacity and to modernize the plant in the interest of greater efficiency. The improvements include several features of special interest.

Lakewood, a City of about 75,000 population, adjacent to Cleveland, built its first sewage treatment works, on the site of the present plant, in 1904, when Lakewood was a Village of less than 5,000 persons. This plant consisted mainly of septic tanks and so-called cinder "bacteria" or contact beds. The City soon outgrew this plant, but it was not until 1916 that a second plant was built on the same site. This plant is still in operation but has again, for several years, needed enlargement and remodeling.

Existing Plant

The existing plant was designed in 1915 to serve 60,000 persons at 100 g.p.c.d. dry weather flow, or 6.0 m.g.d. expected by the year 1930. It originally included two screen chambers with hand raked bar screens; two plain, channel type grit chambers with overhead chain block and bucket for grit removal; Imhoff tanks; and 6 uncovered sludge beds. On account of the rapid growth of the City the 1930 Census showed the population to be 75,509 and the plant was thus overtaxed for several years prior to that date, causing odor complaints and operating difficulties. In an attempt to remedy this situation, four of the six open sludge beds were covered with glass, in 1932, and in 1934 four additional open sludge beds were constructed. Although these improvements were beneficial they did not offset the limited sludge digestion capacity in the Imhoff tanks, which made it necessary to discharge improperly digested sludge onto the sludge beds, with resulting odors.

The effluent from the plant is discharged into Lake Erie, 1500 ft. from shore, in about 20 ft. of water. The sewer system of Lakewood is partially on the combined basis so that much storm water and grit reaches the plant at times of rainfall.

It is interesting to note that the Imhoff tanks, which constituted one of the early installations in the United States, were designed in accordance with the recognized practice at that time which called for 2 hours detention in the flowing-through compartments, and only 0.8 cu. ft. per capita sludge digestion storage capacity. It was soon found, at Lakewood as well as at other early installations, that the digestion capacity, as well as the sludge drying bed area, were inadequate and this condition has given increasing difficulty throughout the 23 years of operation of the 1916 plant. This fact, together with the need for enlargement to meet an increased volume of sewage flow, has resulted in the remodeled plant now under construction, which will thus be the third plant on the same site. A general view of the improved plant, in final stage of construction, accompanies this description.

Present Improvements

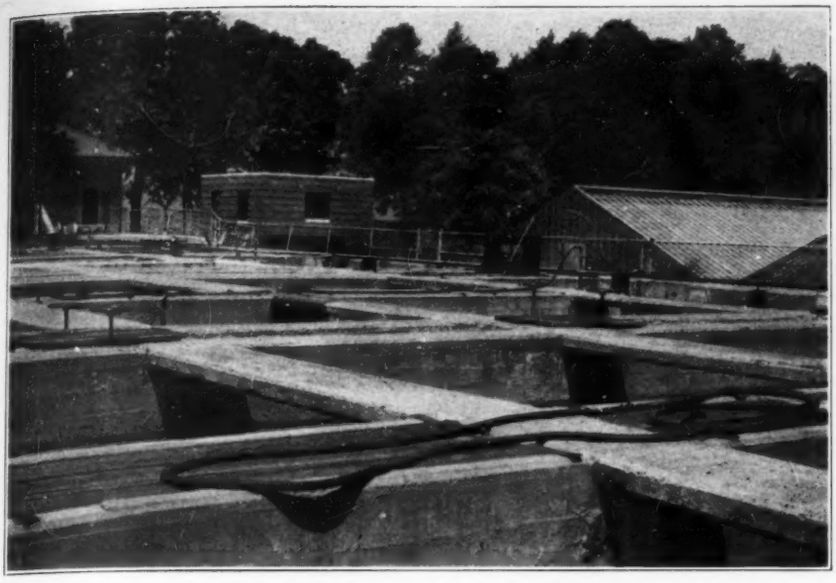
In general, the present improvements consist of prechlorination for odor control; post chlorination for disinfection of the effluent during the bathing season; mechanical screenings removal equipment; mechanical grit removal equipment; a Venturi flume and flow meter of unique design; (And the subject of another article in this issue.—Ed.); two sludge digestion tanks with floating covers, and with full gas collection and utilization equipment; additional sludge bed glass covers; and a new administration building with office and chemical laboratory. The improved plant is designed to serve 86,000 persons at 100 g.p.c.d. or 8.6 m.g.d. average daily dry weather sewage flow, with a maximum rate of flow of double the average, or 17.2 m.g.d. All flows in excess of 17.2 m.g.d. are by-passed just ahead of the plant directly to the river. It is of interest to note that the population for which the present improvements were designed is probably the ultimate to be expected in Lakewood. This is because of the fact that the City is entirely surrounded by other municipalities or by Lake Erie and also because the City is almost entirely built up and is completely provided with sanitary sewers. The various features of the new plant will be described below.

Screenings Removal

In order to modernize the plant and to eliminate odors the hand raked bar screens are being replaced with a mechanical bar screen, of Jeffrey Mfg. Co. make, the second screen chamber being provided with a new, hand-raked, bar screen to provide a standby unit for emergency use. The screenings, after removal of excess water by drainage, will be hauled to the Lakewood garbage and rubbish incinerator.

Grit Removal

On account of the fact that the existing plant was provided with two plain, channel type grit chambers, 51 feet long by 6 ft. 6 inches wide, each of which is of ample capacity to handle the enlarged flow

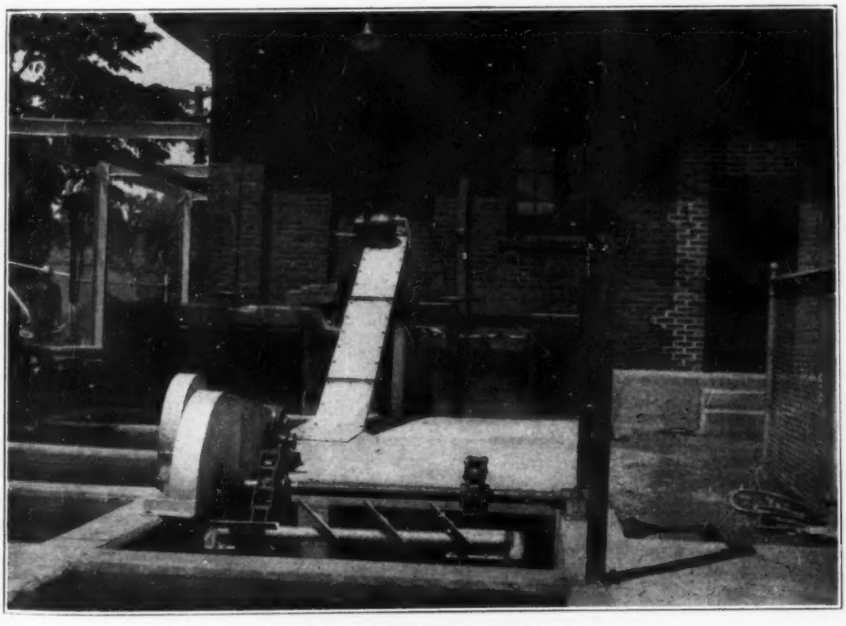


Lakewood's Sewage Treatment Plant III

In the modernization scheme the old Imhoff tanks, of Plant II, are retained as separatory (settling) units, with sludge tranfer to heated digesters, shown in another picture. Glass covered beds have been added also.

to be provided for, it was decided to remodel one of these chambers for the use of mechanical grit removal equipment. The entire flow will normally be passed through this grit chamber, the other chamber, after remodeling, being kept in reserve for emergency use on a plain flow basis without mechanical grit removal equipment. The velocity of the flow in either grit chamber will be maintained between 0.52 and 1.12 ft. per sec., between the normal and maximum quantities of flow, by means of a Venturi flume which will be described below.

The grit removal mechanism, which is being furnished by The Link-Belt Company, is of the conveyor type and is guaranteed, when the velocity of the flow in the grit chamber is within the above limits, to remove 80% of the total grit in the sewage which will be retained by a 50 mesh sieve. The guarantee also provides that the grit removed will contain not more than one percent of putrescible matter as determined by the Dazy churn test. The grit will be collected at a central point 18 feet from the entrance end by motor driven scrapers, from which point it will be lifted through the flowing sewage by a worm type conveyor, discharging onto a platform above the water level. It will be washed by diverting a part of the flowing sewage onto the worm conveyor.



Old Grit Chambers Remodeled

Now equipped with Link-Belt Grit Removal Mechanism and a velocity control Venturi outlet section, shown in another view.

Venturi Flumes and Flow Meter

In order to control the velocity of flow through either grit chamber, within such limits as will permit the guaranteed performance of the grit removal mechanism, and also in order to provide an accurate means of measuring the quantity of sewage flow at all times, a Venturi flume was built into the channel leading to the Imhoff tanks at a point immediately following the grit chambers. This dual purpose use of a Venturi flume is believed to be unusual in its application. In order to determine the shape and dimensions of the Venturi flume to accurately accomplish the above stated purposes, very careful hydraulic studies and tests were made on a model of the flume, by Prof. Geo. E. Barnes in the Warner Hydraulic Laboratory of Case School of Applied Science, Cleveland. From these tests a rating curve of the Venturi flume was prepared and the dimensions of the flume, which is rectangular in cross section, were fixed.*

To measure and record the sewage flow a float meter, with indicating, recording and totalizing register is provided. The float will operate in a float tube located in the screen building and will be connected to the center of each grit chamber by 2-inch galvanized iron piping. The flow meter, which was furnished by The Bailey Meter Company, is built to conform to the hydraulic model studies and will be calibrated, after erection, in terms of the rating curve, to accurately measure and record the sewage flow between 2.0 and 18.0 m.g.d. with a guaranteed plus or minus error of not over 2 percent.

Imhoff Tanks

Because of the generous capacity of the settling compartments of the existing Imhoff tanks, together with the increased efficiency anticipated by the frequent removal of sludge to new separate sludge digestion tanks, additional settling tanks were not considered necessary for the improved plant. Although a 2 to 3 ft. sludge blanket will be maintained in the bottom of the Imhoff tanks in

* A detailed description of the Venturi flume model studies is presented in a companion article by Professor Barnes in this same issue. —Ed.

order to prevent the drawing of supernatent liquor, the frequent removal of sludge will keep it fresh and thus undoubtedly eliminate the usual foaming and other operating troubles of Imhoff tanks.

Separate Sludge Digestion Tanks

One of the principal features of the improved plant is the addition of separate sludge digestion tanks. Two tanks are provided, each 60 ft. in diameter by 21 ft. side wall depth with a maximum hopper bottom depth of 6 ft. The capacity was determined by calculations based on the results of a full week's chemical analyses of daily samples of the Lakewood raw sewage, which were composited from hourly samples, the quantities of which were in proportion to the sewage flow at the time of sampling. From these analyses the following assumptions were made:

Suspended Solids, Raw Sewage—169 p.p.m.

Percentage of Total Suspended Solids Removed in Imhoff Tanks—60%.

Percentage of Suspended Solids Removed (Volatile)—70%.

Reduction by Digestion Corresponding to 70% Volatile—66%.

Moisture Content of Digested Sludge—92%.

Sludge Digestion in 30 Days Without Further Reduction.

Storage Beyond This Time—30 Days.

From the above assumptions the following figures were obtained:

Solids—0.141 lbs. per capita per day.	cu. ft.
Net Volume of Wet Sludge for 30-day Period	71,795
Solids Storage Capacity	28,320
Supernatent Liquor Capacity (3 ft. depth)	8,482
Total Theoretical Capacity Required	108,587
Resulting Per Capita Cacapity for 86,000 Persons—1.26 cu. ft.	

In order to give a factor of safety for the total tank capacity and also to provide a commercial diameter for the floating covers, the tanks were made, in the final design, 60 ft. in diameter with a 21 ft. side wall depth, giving 119,556 cu. ft. total capacity in the two tanks, equivalent to 1.38 cu. ft. per capita.

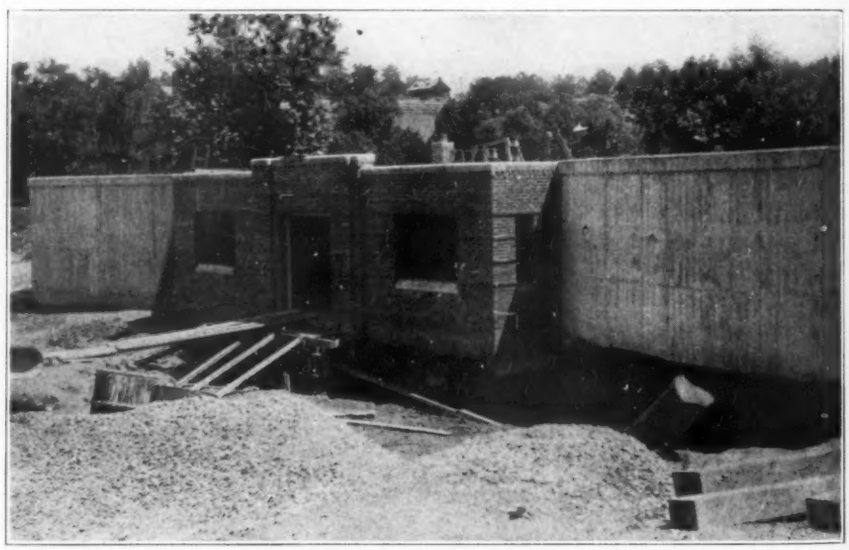
The floating covers, which were furnished by The Pacific Flush-Tank Company, provide for gas collection. The tanks are heated with five 2½-inch genuine wrought iron pipe coils spaced a minimum of one foot from the walls, with malleable iron elbows and four Dresser couplings in each coil, the latter to provide for expansion and contraction. The roofs are of wood with composition roofing.

Dual Purpose Venturi Flume Control Section
At the outlet end of the grit-chambers this section controls velocities and serves as a flow-measuring device. The design and model studies of this control section is the subject of a special article in this same issue by Prof. Geo. E. Barnes.

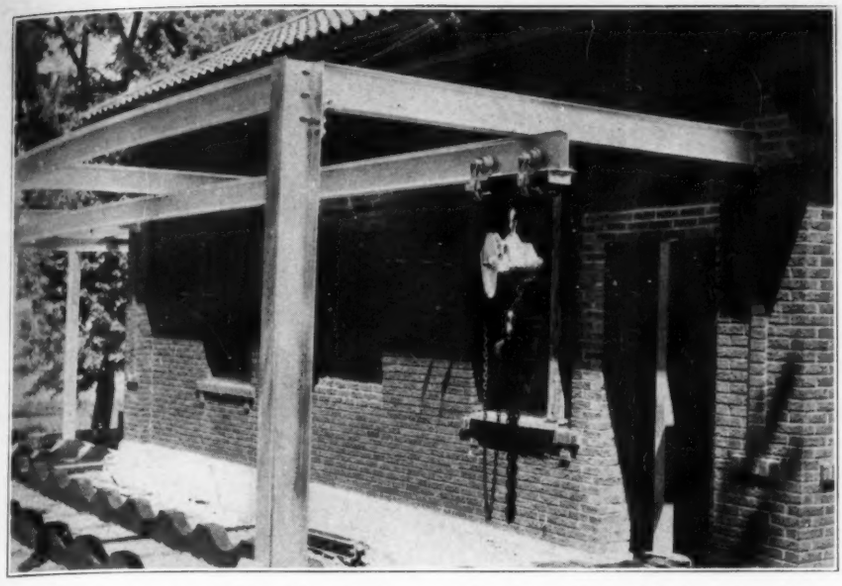
Sludge Control Building

The sludge digestion control building, located between the two digestors, is of two story design. The lower story, below ground level, contains all of the sludge and supernatent liquor piping. The pumps include a Yeomans Bros. Vari-speed drive, centrifugal sludge pump, delivering 50 to 125 g.p.m., and a Yeomans Bros. centrifugal sludge pump delivering 250 g.p.m. These pumps will lift the raw sludge, which reaches them by gravity from the Imhoff tanks, to the digestors, and can also be used either for pumping supernatent liquor from the digestors back to the entrance of the Imhoff tanks or to transfer sludge from one digestor to the other. The pumps may be started or stopped either in the digestor control building or at the Imhoff tanks. They will be under positive suction head at all times, thus insuring ease of operation, with the vari-speed drive pump permitting maximum flexibility in a short period of time.

A Venturi meter, of Bailey Meter Company make, for measuring



Twin Floating-Cover Heated Digesters
The two-story Control House, center, houses sludge pumps, gas fired heaters, temperature control and safety equipment.



Outside Storage and Handling Equipment for One Ton Chlorine Containers

sludge input to the digestors, is also located in the basement of the control house.

The upper story or grade floor level contains the register for the Bailey Venturi sludge meter; a gas boiler of American Gas Products Corp. make, will burn sludge gas to heat water for the coils in the digestors; two Pittsburgh Meter Co. Emco gas meters; two Worthington warm water meters; two Brown Instrument Co., two-pen temperature recorders for incoming and outgoing heating coil water; two single-pen temperature recorders for recording sludge temperature in the digestors; the usual sampling devices, flame traps and waste gas burner, as well as an air exhaust fan which takes its suction from the floor of the basement.

Exhaustive studies and calculations were made to determine the advisability of using sludge gas to drive a gas engine driven generator set to meet all electric power requirements at the plant. These studies showed that this was not economical at the present time, but the control building was made large enough to permit such an installation at a later date.

Chlorination; Pre- and Post-

Another feature of the improved Lakewood plant is the chlorinator and chlorine handling equipment. It was recognized that chlorination of the raw sewage for odor control was essential at Lakewood. Also, since the plant gives preliminary treatment only and the effluent is discharged into Lake Erie, post-chlorination of the final effluent may be required for disinfection during the bathing season. For these purposes it is estimated that up to 1000 pounds of chlorine per day may be required, at times. It was accordingly decided, in the interest of economy, to provide for the purchase and handling of chlorine in ton containers. For this purpose a chlorine storage platform was constructed on the end of the screen and chlorinator building, where it will be easily accessible to the entrance driveway. A platform scales, to hold two one-ton chlorine containers, was built into this platform, with the beam arm located inside the building. For unloading the containers from the trucks, an overhead mono-rail and chain hoist were provided, as shown in an accompanying photograph. This mono-rail extends over the length of the platform and along one side of the building, thus providing ample facilities for storing 17 filled and empty containers. This will permit the shipment of chlorine in carload lots of 15 containers each and leave room for storage of empty tanks. A pipe manifold will permit the simultaneous feed of chlorine from four containers, if desired, in order to prevent chill and low pressures caused by too rapid feed from a single tank.

The chlorinator, of Wallace & Tiernan make, is of the manual control, solution feed type and of 1050 lb. daily chlorine capacity. Automatic proportional feed was not deemed necessary because of the fact that the dry weather flow reaching the plant is unusually constant for 15 to 18 hours of each day. The chlorinator is located in a separate room built into the screen building, with entrance only from the outside wall. This room is ventilated with an electric fan. The chlorine solution is discharged either through a manifold grid in the influent chamber, ahead of the screens, or into the 24-inch concrete outfall sewer siphon pipe near the screen chamber.

Administration Building

The improved plant includes a new administration building which is of two-story, brick construction. The upper floor contains the office and a complete chemical laboratory, with space for bacterial laboratory equipment. The lower floor, at grade, will provide garage space for three automobiles, a boiler room for heating, using sludge gas as fuel, and a workshop. The landscaping of the site, already fairly complete, will be improved.

Personnel

The plant improvements were designed and the construction supervised by the office of Rollin F. MacDowell, Consulting Sanitary Engineer, Cleveland, Ohio, with A. E. Scheible in direct charge of construction. Amos I. Kauffman is Mayor and Service Director of Lakewood, and Edward A. Fisher is City Engineer, Michael Stedman was Resident Engineer of construction for the City. The construction work was done by W.P.A. at a total cost of about $200,00, the city supplying $82,500 of this sum.

NEW ENGLAND SEWAGE ASS'N TO MEET AT TOY TOWN TAVERN

On Friday and Saturday, Sept. 29th and 30th the New England Sewage Works Association will hold its Fall Meeting at popular Toy Town Tavern in Winchendon, Mass. On the map it would appear to be an ideally located spot for the meeting. On the folders showing the facilities for sports and recreation, Toy Town Tavern would seem to be the ideal spot, in the ideal spot. Warnings have been sounded by Secretary Van Kleeck to make reservations early.

A high light on the technical program will be the appearance of the Chief Engineer of the Mass. Dept. of Health, to review developments at the famed Experimental Station at Lawrence where Sanitary Engineering was born and cradled.

PRE-CHLORINATION PLUS

An Open Letter from One "Super" to Another

By R. G. Yaxley, Supt.
Water Commission
WATERFORD, NEW YORK

"Bob"

Dear Jim:

Received your letter O.K. and am glad to hear that you have that new pump, it was sure needed and the saving in power will pay for it, but I can't see why you should be so "het" up over its having ball bearings. Oh! I know that you got filled up at "Tech" with "friction loads" and the "evils of metallic contact" in bearing design, but we have an old pump that has been in use since 1921 and if you can get a .005 feeler in the bearings I'll buy the beans the next time you are down. If those ball bearings are running in 1957 just call me up.

Was over to the county seat the other day and stopped in to see Pete, found him at his river plant and up to his old tricks. You never want to pass up calling on Pete when you have the chance for while he has a small plant, it's a tough bird to run and he is the boy to run it. Got to give his Water Board some of the credit too. All they ask for is *results;* methods are up to Pete and they back him to the limit. You know what kind of a raw water he has, takes it out of the river which is fairly soft, hardness averages around 28 P.P.M., M.O. Alk' the same, Color 30 and pH from 6.80 to 7.10. Turbidity of any amount is rare as the whole stream is a series of mill dams, with natural ponds and artificial storage all over the water shed about the same type as that "sparkling mountain stream" you have to contend with, except Pete has a nice run of sulphite waste from a couple of paper mills. Taste and odor control is the problem.

Some of Pete's Troubles

Over a period of years Pete has fussed with sulphuric acid for pH control of coagulation, carbon all over the place, even in his hair, a spray nozzle aerator or filter effluents, ammonia, and most everything else he heard about, without any real results. About five years ago he started pre-chlorination, began his plant runs in mid-winter when conditions are the best at his place and of course used ammonia which, in those days, was a cure for everything from mud balls to tuberculation.

Everything seemed to be fine and Pete was about sure that he had it that time, but when the river temperature got up around 55 deg. in the late spring, bugs began to show up in the clear well. With sterile water on top of filters, effluents had counts in the hundreds, nitrites was the answer of course. Well Pete cut out the ammonia, and the counts disappeared, but he could not hold an excess through his filters during warm weather. Each year he has increased his pre-chlorine feed over that of the previous summer, endeavoring to get that desired excess through, but no luck. You know the average water man begins to back up whenever two or three P.P.M. of chlorine dosage is proposed for drinking water. We have all heard too many yells from John Q. Public about "chlorine tastes."

But Pete Doesn't Balk

I have been interested in this phase of Pete's work and that is one reason I went over to see him; and, was it worth while? You know that bird has "guts," more nerve than I would have under the same circumstances. The day I got there he was feeding 10½ P.P.M. of real chlorine. (ten and one-half, count them) into his raw water, couldn't tell what the excess was after 15 minutes contact, but it was over 8 P.P.M. The filter effluents showed about 2½ parts and aerator outlet over two parts. And, believe it or not, you could smell, drink or boil that water with over two P.P.M. free chlorine in it and I defy your nose to find a trace. And, that isn't all, after giving it a shot of ammonium sulphate he was sending it into town, *and no complaints,* in fact he told me that a number of consumers had stated that the water was much better than usual. Previous to the use of pre-chlorine, an excess of 0.25 P.P.M. residual going out of the plant was just plain asking for complaints. Another interesting point was that he has been able to reduce his alum feed better than 20% compared with previous seasons, and you know the dry spring and summer has made all of our supplies tougher than usual.

Some of Pete's Results

He gave me some figures that might be of interest, they cover the period of July 22nd to August 18th, inclusive:

Ave. pre-chl. feed	9.45 p.p.m.		Ave. post-chl. feed	.76 p.p.m.	
Max. " " "	10.71 "		Max. " " "	.78 "	
Min. " " "	8.76 "		Min " " "	.0 "	
And the following are averages:					
Raw water	37°	Count 7,256		Coli	1/50 cc +
Basin inlet	37°	" 8—		"	10 cc —*
Basin outlet	37°	" 1+		"	10 cc —*

* Not even a presumptive gas former for the month.

(A larger meter was installed on the pre-chlorine machine on August 8th, previous to that it was necessary to use post chlorination also.)

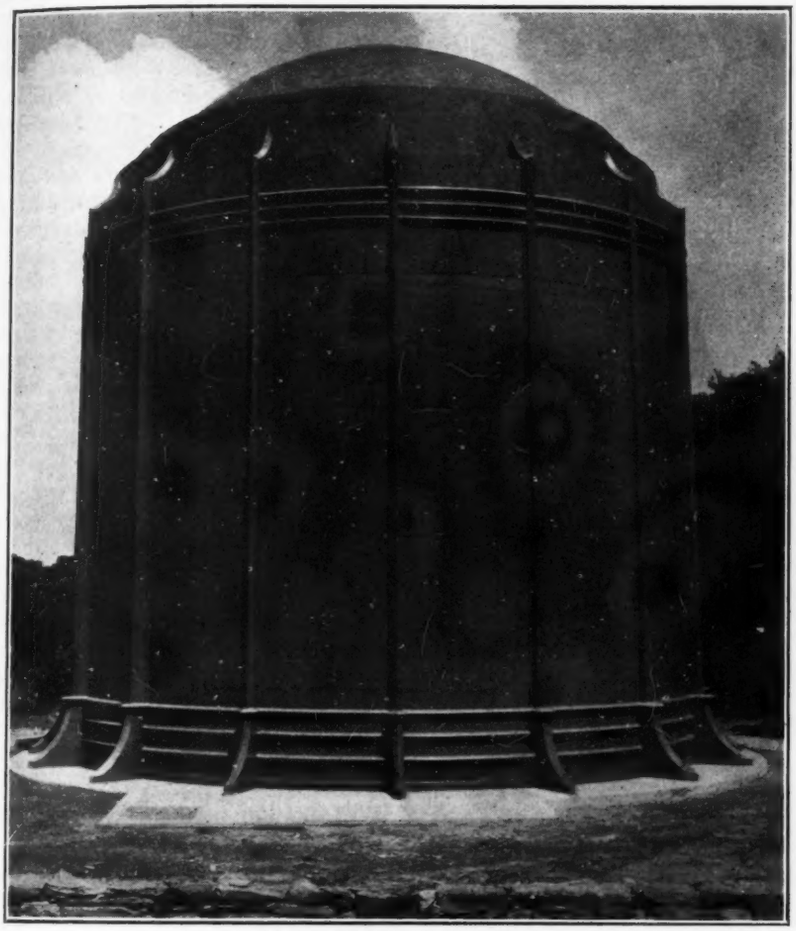
The average oxygen consumed of the raw water is around 13, and previous to this summer a 55% reduction through the plant was about the limit. The average reduction for the above period was 79%, with a maximum of 94%. Now, something has really happened to that organic matter, and it sounds like *real* oxidation to me.

After we got through at the plant, Pete asked if I wanted a ride ,so we drove up the main street a few blocks to a gas station and then on to a small grocery. At each place he picked up a water sample and I noticed he wrapped them up to keep the light away. Back at the plant he ran excess chlorine tests, and when I stared at the results Pete grinned. No wonder: With over two P.P.M. of a 1 to 3 ratio chloramine excess leaving his plant, 20 minutes flow time away it was down to 1.0 P.P.M., and less than one hour away there was only a trace. If you have the answer sing out, Pete will be listening. I have an idea his mains have that accumulated organic coating in them, which takes up the residual.

Well, I'll have to sign off. Next time you're down bring the better half and plan to spend the night, we are always glad to see you.

"Bob"

[Note: While we hate to give "Bob" away—"Bob" is really "Pete" and "Pete" is the true author who gives us in this interesting "Open Letter" his own experiences at Waterford, N. Y.—Ed.]



The Standpipe of Mamaroneck*

DESIGN DIGNITY

It is particularly pleasing to note that standpipes and water tanks are in numerous cases no longer just that.

To the older generation of water works men a reservoir is something attractive; the stand-pipe something to put up with. And, the residents of the community have their own ideas in the matter. The following is a case at point.

To overcome objections from nearby property owners to a proposed stand-pipe in a fashionable hill-top area of Westchester County, the water works authorities of the Town of Mamaroneck, N. Y., showed the objectors (more importantly their legal representatives) an artist's sketch which pictured the stand-pipe here shown. To the objectors this was a "different sort" of stand-pipe and the 43 ft. diameter reservoir, here shown, was built to their satisfaction. There was little additional expense in providing the design here shown, but what a difference the architectural trim and Grecian lines make when it comes to public opinion.

*Photo by courtesy of Pittsburgh-DesMoines Steel Co.

OHIO SEWAGE CONFERENCE PROCEEDINGS PUBLISHED

The 12th (1938) Proceedings of the Ohio Conference on Sewage Treatment of 160 pages has just been published.

In it appears the "Report of the Committee on Sewage Filtration" which contains much authentic and valuable information pertaining to design and behavior of sewage filters, permissible trickling filter loadings and considerations in the operation of these units being featured in the report.

Amongst the technical papers and discussions appear the following: "Activated Sludge Bulking — Some Considerations as to Causes and Corrective Measures"; "Aero-chlorination: A Development for Grease Removal"; "Symposium of Five Year Sludge Digestion Studies at Cleveland"; and "Gas Engine Operation at Toledo." (Other shorter papers covering operation problems, experiences and studies include "A Symposium on Mechanical Filtration of Sludge at Barberton, Columbus and Cleveland"; "Five Year Operation Program at the Ravenna Sewage Treatment Plant"; "Measuring the pH of Sewage Sludge"; and "A One-Man Operated Sewage Plant."

The 12th Annual Report is available to non-conference members at $1.25 per copy. A limited number of extra copies printed for such distribution as long as the supply lasts. Ben H. Barton (Treasurer), Supt. Sewage Treatment Works, Findlay, Ohio, has been authorized to accept orders.

MINNESOTA SECTION OF A.W.W.A. MEETS IN DULUTH

By HARRY A. FABER*
Associate Editor
WATER WORKS AND SEWERAGE

MARKED by several "first" events, the Twenty-Third Annual Meeting of the Minnesota Section of A.W.W.A. in Duluth proved to be an historic occasion.

Before the formation of this section, two presidents of the national organization had been elected from Minnesota—in 1888 and again in 1898. Since the organization of this section, J. Arthur Jensen, Engineer of the Minneapolis Water Department, is its first member to be selected as president of A.W.W.A. As chairman of the section this year, his was the first visit of a national president in 41 years.

But that is not all. The Duluth meeting was honored at the same time by the official visit of Norman J. Howard, Toronto, Canada, vice-president of the national organization.

Even more: Members were proud to learn of a welcome increase in membership during the past year, from the previous 48 to the present 65 members. At the meeting on August 24th and 25th a total of 97 were registered for the sessions.

A variety of entertainment was provided following the technical meetings. Trips during the two days included those to the city's Lakewood Pumping Station, to Distribution Division Headquarters and Garage as well as speedboat rides for ladies on Lake Superior. Special arrangements were made for those who could spend the day following the meeting either on deep sea fishing trips or on a conducted tour of the large iron ore mines at Hibbing.

Officers Elected

Chairman:
Edwin M. Grime,
Chief Engineer, Water Service Dept.,
Northern Pacific Railroad,
St. Paul

Vice-Chairman:
A. C. Janzig,
Bacteriologist,
Mill City Water Plant,
St. Paul

Secy.-Treas.:
R. M. Finch
Wallace and Tiernan Co.,
District Manager,
Minneapolis

Director A.W.W.A.:
Felix Seligman, Mgr., Duluth Water and Light Dept.

Trustees:
Frank Rabb,
Minneapolis
W. J. Siebert,
St. Cloud
W. P. Tarbell,
Fargo

Edwin M. Grime
St. Paul
New Chairman of Section

A. C. Janzig
Minneapolis
Elected Vice-Chairman

Vice-President Howard Notes A.W.W.A. Benefits

Bringing a message from the national association to this section, Mr. Howard reviewed highlights of the sixty years during which the Association has existed and described some of its many advantages to members.

Until 1908, he mentioned, activities of members were concerned largely with the supply of water in the quantity necessary for ever increasing demands. More and larger impounding reservoirs were built. But with increasing population and industrialization, pollution of water supplies increased accordingly. Due to this increasing contamination, the death rate from typhoid fever had reached the appalling figure of over 80 per hundred thousand. The cost of these deaths was estimated at enormous figures and indirect costs of cases which did not result in death, but were greater in number, was equally large. Early studies were made on water analysis and of water purification methods.

Only when the installation of filtration processes became general, and when chlorination was adopted for the more polluted supplies, did a marked decline occur in the typhoid death rate. Describing early studies on chlorination by Sir Alexander Houston, with whom he worked in England, Mr. Howard revealed some of the public skepticism which first met this new process. The development of equipment to apply liquid chlorine and the widespread adoption of such a disinfection process in the United States by the water works profession progressed much more rapidly than abroad. Only when several epidemics proved its necessity has chlorination become generally utilized in England.

Water purification research here was interrupted by the world war, but the period since 1919 to date has been an amazingly fruitful one. Studies on water chemistry, mechanical devices, filtration methods; redesign and remodeling of plants using this new knowledge; concern over taste and odor and the use of ammonia, superchlorination and dechlorination, activated carbon both granular and powdered; all these have contributed to the quality of water and to the complexity of treatment processes.

In large part the present stage of development has been reached by cooperation of the A.W.W.A. members aided by State Health Departments. The annual association meetings and the various sectional meetings have made possible the necessary interchange of information and ideas. Many improvements have resulted also from cooperation of the manufacturer's association. The advantages of membership in these cooperative efforts reach every individual, through meetings and fellowship and through the journal of the association. This section was complimented on its growth, but a tremendous potential field of increased membership was pointed out. The speech was stimulating and timed to develop a greater participation in association affairs—which will find

* Research Chemist, The Chlorine Institute, Inc.

Minnesota enthusiastically supporting its president.

Technical Papers

"Plumbing Cross Connections"—by Felix Seligman, Manager, Water and Light Department, Duluth.

Considerable study has been devoted to determining the serious potential danger of plumbing cross connections, while but little progress has been made in correcting these conditions, according to Mr. Seligman. He emphasized that definite evidence proved our present installations of plumbing could, under certain conditions of operation, be capable of seriously infecting the water supply to which they are connected. Investigations following the outbreak of amoebic dysentery in Chicago and other instances were given as examples.

Few officials have yet revised local regulations to classify any type of plumbing as a cross connection. Usually the direct connection of the municipal water supply with any other supply is prohibited, but so-called "hazardous plumbing" cannot be included. While the regulations can readily be rewritten so as to class all undesirable fixtures with prohibited cross connections, still the enforcement of such a regulation would be difficult or even impossible. Four reasons for such a conclusion were given:

1. The cost of replacing undesirable plumbing fixtures and defective plumbing.
2. That type of fixtures desired is not, as yet, being produced by manufacturers.
3. The public has not been educated either to realize the dangerous conditions which can be caused by certain types of plumbing fixtures and piping or to demand approved fixtures and piping.
4. A lack of cooperation between water works officials, city and state health departments, plumbers, and manufacturers.

The Water and Light Department of Duluth, with assistance supplied by the W.P.A., has made a survey to determine the extent to which undesirable plumbing fixtures were installed as well as to check the accuracy of the preceding points. Some 422 buildings of all types except dwelling houses, apartments, grocery and meat shops, have been inspected. A total of 17,170 plumbing units (such as wash basin, sink, etc.) and the piping arrangement connecting these units to the city water supply were inspectd.

Of these, 7,514 units had submerged outlets or were otherwise designed so as to constitute a possible means of contaminating the city water supply to which they were connected. In addition 2,514 units were directly connected to sewers (2,353 of these units were flushometer type toilet valves) and the remaining 189 units consisted of miscellaneous types of undesirable piping layouts and equipment using city water.

R. M. Finch Again Secretary-Treasurer — *Felix Seligman National A.W.W.A. Director*

It was not only apparent that the correction or replacement of all undesirable types of plumbing conditions discovered would be costly, but it was further learned that a more desirable type of plumbing fixture was not always available. During 1937 the Minnesota State Board of Health, after an inspection of the Duluth water system made several recommendations. One recommendation required the removal of flushometer type valves and connection of piping so that water within the piping could under no condition be siphoned back into the water supply system. A sketch of the proposed connection was submitted to plumbing manufacturers who, without exception, reported that they did not make or contemplate making such equipment.

The author proposed that the Plumbing Codes should follow the example of more critical and complete Electrical Wiring Codes. They would then include proper engineering of piping layouts, and the necessary data as to water requirements of various types of equipment.. This should insure ample pipe sizes and avoid a hazardous plumbing condition. In conjunction with a plan to educate the general public it would materially aid in the gradual installation of safe fixtures.

Thus far, some six years have been spent in discussing the subject of cross connections and plumbing hazards, but no agreement has been reached as to the proper plan of action. Eternal vigilance to protect water supplies from contamination was indicated as the price necessary to pay for the existence of such hazards.

"Trends in Water Works in 1939"—by L. N. Thompson, Genl. Supt. and Engineer, Water Department, St. Paul.

The determination of trends requires a review of those functions whose development has most recently engaged the water works profession. In the presentation of such a review, with proper emphasis and evaluation, Mr. Thompson proved highly competent.

Administration of water departments during the past few years has presented problems of particular difficulty. Increases in the cost of labor and of materials have been accompanied by economic conditions which necessitated strict economy. There have been unusual budget decreases, large delinquent lists, and consumers have become increasingly critical of water quality. In addition, the unemployed of a municipality have been quick to resent the steady employment of those in the water department.

In this situation, utilities have been made to realize the value of good public relations, public education, and public confidence. Resultant training of employees has brought about a more healthy condition: "Publicity may emanate from the head of the department, but good will is gained or lost through the employee."

The old order of restricting the use of water has changed—now efforts are made to promote sales. Proper size of services and meters, and a higher percentage of meter efficiency, has reached a national demand. Apparent economy to the consumer of a small connection will soon be forgotten, but poor water service—that is, poor pressures—will always result in complaints.

Through government financing of projects, which now appears to be ended, some cities have completed major construction for years to come. Others who have been unable to take advantage of these means, will soon be forced to make capital improvements which have, in many instances, already been too long delayed. In the future, better maintenance and improvement of existing works will assume greater significance. Because recent studies have shown the relatively high rate of depreciation in small pipe lines, in comparison with larger sizes, due to decreased carrying capacity, larger piping and various interior coatings

will receive more recognition. Cathodic protection of steel standpipes, which prevents corrosion and yet is low in installation and operation costs, may be more widely used.

Rubber caulking material is new but seems to offer great possibilities. Costing little more than the best hemp, it has been found to enable perfect caulking of bell and spigot joints, yet has the important advantage of harboring no bacteria.

More thought is now given to maintenance and prompt repair of the distribution system. The city of St. Paul is preparing to equip three emergency trucks and a maintenance car with one-way radio receiving sets in order to reach crews through the police radio system for any emergency at any time.

Improvements in filtration and softening plant design were properly commented upon. Construction of the new St. Louis plant as two individual units, increase of filtration rates in several plants to a new 3 or even 4 gal. per sq. ft. per min., higher wash water rates, and automatic control of equipment were some of the features commented upon. Thus a trend appears to be the development of water treatment which is broader than mere purification. Devices to accelerate flocculation and precipitation have developed with the public demand for soft water.

The large increase in municipal sewage treatment plants has frequently resulted in use of water department facilities for collection of the sewer rental charge. These many new functions and improvements have found the individual, local group, and state section of the water works profession growing steadily with the national organization, so that the "trend" is to greater service and accomplishment.

O. E. BROWNELL, Engineer, State Dept. of Health, in discussion illustrated the trend to increased water conditioning in Minnesota. In the last 18 months some 15 plants have been constructed for iron removal and eight other plants either built or under design for water softening purposes.

"Experiences with the Zapffe Catalytic Process" by A. M. KIRCHER, City Engineer, Mankato.

It was long known that the Mankato water supply contained considerable quantities of iron, but the mud-like deposit in mains and service lines did not appear characteristic of this mineral. Hard layers of the material had built up and reduced the volume of flow, increased velocity and pressure resulted in a deposition of the substance in valves, faucets, and meters. In addition, bathroom and kitchen fixtures were stained, fabrics were discolored in washing. This deposit was a dark brown, solid incrustation in the mains, yet appeared at the faucets as a yellowish, free flowing material.

Norman J. Howard and J. Arthur Jensen Vice-President and President of A.W.W.A. Honor Minnesota Section

Experiments with the raw water showed that a part of the material could be removed by aeration and subsequent sedimentation. Pilot plant studies of other removal methods did not show any completely effective. It was then learned that the so-called Zapffe Catalytic Process (named after its originator) had been in use for the removal of iron and manganese from the water at Brainerd, Minn., since 1932 and was giving very efficient results. The conditions at Brainerd were so similar that it was finally realized the Mankato problem was one not only of iron removal but of large amounts of manganese as well. From analyses of water in the mains it was found that 80% of the manganese was deposited in the first half mile of flow.

A. M. Kircher, City Eng., Mankato; D. M. Wallace, Dist. Mgr., American C. I. Pipe Co., Minneapolis; O. C. Ayliffe, Supt. Filtration, Fargo, N. D.

The Mankato supply is derived from three 20-inch drilled wells varying from 57 to 65 feet in depth. It has an average pH of 7.8, about 4.0 p.p.m. of iron, and 0.9 p.p.m. of manganese. Removal of the iron and manganese is effected by passing the raw water through a bed of pyrolusite (impure manganese dioxide) ground to pass a 10 mesh and to be retained on a 40 mesh sieve. Flow is upward through a bed 16 inches in depth. The water then drops to enclosed aerating pans and a steady flow of forced air is constantly maintained to increase the effectiveness of aeration. These pans are located directly above a 60-inch depth bed of coke where fixation of iron and manganese takes place. In theory, the pyrolusite bed acts as a catalyst, and influences the more rapid oxidation of the manganese present, so that after aeration both manganese and iron will deposit in the coke contact bed.

An average of 3.5 m.g.d. of water is treated by this process and by rapid sand filters following it. Continued operation has shown about 15% of the iron to be removed in the pyrolusite bed, 85% in the coke filter. Only 2% of the manganese is removed in the pyrolusite bed, the remaining 98% depositing in the coke filter. The plant has been in operation for 328 days and no trace of either iron or manganese is ever reported in the treated water. Mr. Kircher said all units of the plant are completely enclosed, the installation is low in cost and he described it as extremely simple in operation.

OLE FORESBERG, Water Supt., Hibbing, commented on study of the manganese problem for the past 15 years. At Hibbing the 3.5 miles of main between the filter plant and the city also accumulate manganese deposits but, since there are few consumers in this distance, the deposit is flushed periodically and actually constitutes the manganese removal system. Experiments have shown manganese deposits to be true zeolites; they will soften water and can be regenerated.

In his opinion the pyrolusite bed is unnecessary—and at another plant it was demonstrated, by bypassing this unit for two months, that the coke filter alone was equally effective. Manganese and iron can be removed with equal completeness by the standard lime-soda process which softens the water at the same time. For manganese removal a high pH (about 8.4) is necessary.

O. E. BROWNELL, State Dept. Health, Minneapolis, commented on two other lime-soda softening plants in the state which show equally good iron and manganese removal. At one plant tests have shown as high as pH 11.0 to be necessary for complete removal of manganese.

"Water Supply for Railways" by EDWIN M. GRIME, Engineer of Water Service, Northern Pacific Railway, St. Paul.

In this extremely comprehensive paper, Mr. Grime discussed the importance of water quality in modern locomotive or railroad power plant boiler operation. The quantity of water required by a steam railroad exceeds in volume and in weight all other railroad materials combined and more than half of this consumption is required for steam generation.

The consistent maintenance of a definite alkalinity, in relation to the total salts dissolved in the water, under modern conditions of high boiler pressures, has become as important to the life of a boiler as is disinfection of a drinking water supply for human consumption. It may be possible to obtain suitable water from municipalities, but usually the supply must be developed from a lake, stream, or underground sources. As a result, almost every conceivable problem must be faced by the railroad water engineer.

When rivers are used as the source of supply, numerous conditions may be met: intakes must be developed to reach below low water, they must not be disturbed by moving ice, or buried by shifting beds of river silt. It may be necessary to utilize open, dug wells from 20 to 100 feet in depth, or drilled wells from 100 to 1500 feet in depth. To best suit conditions, pumping plants may involve steam, air, fuel oil, or electricity, and pumps of reciprocating, centrifugal, turbine, and air lift types.

Modern railroad operation cannot be successful without softened water. Methods of wayside treatment, which require but a small expenditure for equipment and which are almost entirely automatic in operation, are used in those plants where lime soda softening is not justified. In 1924 a profile was prepared to show every water station between Duluth, Minn., and Seattle, Washington, noting the total dissolved solids, total hardness, and sulfate hardness. Total dissolved solids vary from 5 grains per gal. on the Pacific coast and near Duluth to peaks of 65 to 140 grains at points in Montana and North Dakota.

The Water Committee of the Railway Engineering Association has developed a formula which shows damage to a locomotive boiler, by reason of the accumulation

O. E. Brownell, Engr. Minn. Dept. of Health, Minneapolis; Ross A. Thuma, Supt. Filtration, St. Paul; E. H. Ruble, Public Health Engr., Duluth

of one pound of scale-forming material, amounts to $.13. This figure includes: Loss of fuel through insulating effects, renewal of flues, cost of labor, loss of engine time. As a result of this water supply study, the Northern Pacific now has in main line bad water territory a total of 33 softening plants at a total cost of $575,000. During the past eight years, these plants have shown an average annual saving of $146,000. Taking into account interest and depreciation on the investment, this is a return of 25% per annum.

Continuous treatment plants employing lime and soda ash are almost universally used, often with the addition of sodium aluminate for floc formation and to effect better removal of magnesium. In order to prevent after-precipitation the addition of very small amounts of organic matter, such as tannin or phosphate has proven a desirable refinement. An excess of caustic alkalinity in the delivered water is desirable in order to prevent reversible reactions. All water over the operating system is brought to practically the same degree of hardness and conditions are thereby stabilized.

From other states: R. M. Jenson and J. D. Turner, Water Dept., Grand Forks, N. D.; L. P. Madsen, Water Dept. Supt., Huron, S. D.

However, where the raw water is high in sulphate salts, the softening process makes little difference in the total quantity of dissolved solids. When dissolved solids become high in the boiler water they may combine with a small amount of suspended solids to cause carry-over or foaming. If it is not practicable to blow out boilers to prevent this, anti-foam compound may be applied by the engine runner at the rate of a pint to each 5 or 10 thousand gallons of water. This is an emulsified solution of tannin and organic material with castor oil, which has the tendency of decreasing the surface tension of steam bubbles and of so weakening them that they collapse. Unless this is done, they will carry over into the cylinders where the moisture tends to destroy lubrication. Eight years of water treatment has extended the life of locomotive tubes and flues to at least 12 to 15 years instead of the former 18 months.

A recent development is the treatment of water required for the steam generating units of fast stream-liner trains operated with Diesel power. These are exceptionally small flash-type boilers, allowing only a few minutes to change cold water into steam. Because of the large number of small tubes in these boilers, no incrustation can be permitted and solids in the feed water must be reduced to the minimum. An ion-exchange filter has been designed to obtain the pure feed water required.

This is actually two units. In filter number one, containing granules of sulfonated lignite, the positive ions such as calcium, magnesium, and sodium, are replaced by hydrogen ions. Passed next through filter number two, which is a bed of granulated phenolic resin, the negative ions such as sulfates, carbonates, and chlorides, are replaced with hydroxyl ions. Thus, the final effluent is H from filter number one and OH from filter number two, or practically pure water.

The cost of such treatment is usually under fifty cents per thousand gallons and the water contains less solids than ordinary distilled water, which costs about $5.00 per thousand gallons. Regeneration of the first unit employs sulphuric acid and that of the second unit, caustic soda. In addition a zeolite softener is provided to wash the second unit with soft water, and a decarbonator to remove carbon dioxide from the treated water must be used.

Mr. Grime discussed the problem of embrittlement and intercrystalline cracking. He noted that it has now been proven that lignin, cutch, and some other organic compounds—which are entirely practicable to use in boiler waters—prevent intercrystalline cracking and are much more effective than sodium sulphate. He also mentioned the effective use of coal filters to remove oil contamination from condensate and low pres-

(1) Paul Stauff, Water Dept., Eveleth. (2) Ole Foresberg, Water Supt., Hibbing. (3) Carl W. Seeman, Water Dept., Minneapolis. (4) E. O. Welde, Engineering Improvement Bulletin, Minneapolis. (5) Leonard Powers, Water Dept., East Grand Forks. (6) H. C. Lindsten, W & T Co., Winnipeg, Canada. (7) R. W. Ockershausen, General Chemical Co., Chicago, Ill. (8) Especial mention earned by Mrs. Ruth P. Hansen, for twelve years "secretary to the secretary."

sure steam returning to the boilers. Oil penetrates the fine coal only an inch or two and is removed by backwashing.

"An Evaluation of Cross-Connection and Back-Siphonage Protective Methods" by F. M. DAWSON, Dean, College of Engineering, State Univ., Iowa City, Iowa, and A. A. KOLINSKIE, Research Engineer.

The junior author presented this paper on what he termed a controversial subject. There are several possible methods of preventing such contamination but hardly one best method. Advantages and disadvantages of several proposed methods were outlined and commented upon.

1. Perhaps 90% of all back siphonage is caused by the formation of vacuums in the piping installation. A logical preventive method would be to prevent this happening by the use of larger pipe sizes. But even if larger pipes are used and if higher pressures are maintained complete water shut-offs will still cause a vacuum. This method can only partially prevent back-siphonage.

2. Air inlet devices. It is practically impossible to make these sufficiently large to prevent the formation of vacuum under extreme conditions. They are not desirable for general use because the design of such devices, which will operate infallibly with the slightest vacuum and yet be always closed at other times, is only theoretically possible.

3. The separate supply method. This would be a satisfactory solution for some large buildings and certain industrial conditions. By feeding all unsafe fixtures by gravity from a roof tank or by a supply pumped from a surge tank, the closet bowl problem could be solved. Such a separate supply, however, might later be unintentionally cross-connected to the potable supply. Also there are many unsafe fixtures—particularly in hospitals—which require direct water supply. The method has its place, but is not ideal for general use.

4. The raised water inlet. Obviously, there is no back-siphonage problem if the water inlet is not submerged. The fault of this solution is that it is too easy to make a raised inlet into a submerged one through the use of a length of rubber hose. There is still a potential danger with this method until the public and plumbers are educated to a realization that an air gap must remain so if it is to offer protection.

5. The vacuum breaker method. This device must always be located on the discharge side of a control valve and may be used when it is essential to have submerged inlets. There must be one on each fixture of this type, and it is probably the most economical solution for old fixtures. But there are good and poor designs.

Thus there is no standardized or entirely advisable method, but a selection should be made to supply the most protection for the investment. A false sense of security should not be attributed to any protective means used.

"Stillwater, Minnesota, Water Works System Historic and Unique" by HERBERT S. GROVE, Genl. Mgr., Bd. Water Commrs., Stillwater.

Careful research was apparent in the paper presented by Mr. Grove, who sketched the colorful background of the Stillwater system. His paper carried listeners from the developments of pioneer days, when a pair of Indian ponies operated a treadmill to pump water for a few customers up to the present. Springs, lakes, and even a "duster" oil well that yielded instead a continuous supply of good water—all have their place in the story.

"The Effect of Disposal of Sewage and Industrial Wastes Upon Surface Water Supplies" by H. G. ROGERS, Public Health Engineer, State Bd. of Health, Minneapolis.

Mr. Rogers presented his material under this title very graphically by means of motion pictures. In a short preliminary talk he explained the chemical and biological procedure involved in the measurement of pollution, and described portable equipment used in field studies. His pictures, however, spoke for themselves. They made very clear the condition of streams before the advent of waste treatment and contrasted with this the improvement which followed. Various types of treatment plants, constructed to produce the degree of purification consistent with the waste and with the dilution available, were shown in detail.

"The Meter-Master, The 'G'-Man of the Water Works" by FRANK BRAINARD, JR., F. S. Brainard & Co., Hartford, Conn.

In the absence of the author, this paper was read by Mr. E. W. Johnson, Sanitary Engineer, Minneapolis. The device was not described but the paper was devoted to discussion of the many ways in which it has become practically indispensable to the city of Hartford. Elimination of customer antagonism is accomplished in almost all cases of complaint over unusual meter readings when the Meter-Master is installed. The subsequent record of water flows enables the customer to convince himself when, where, and how the water was used.

Another use of this equipment is in periodic checks of meters. A 24 hour test period is compared with the rate record and many instances of over- or undersized meters are found. Replacement with the proper meter size brings numerous increases in revenue.

(1) Phil Lundmark, Water Commr., Mankato. (2) D. B. Morris, C. B. Lyon, Inc., St. Paul. (3) D. E. Colvin, Intl. Filter Co., Minneapolis. (4) E. P. Eilertson, Supt. Water Dept., Mt. Iron. (5) Frank Raab, Chemist, Water Dept., Minneapolis. (6) F. G. Clark, Repr. Worthington Pump Co., St. Paul. (7) E. W. Johnson, San. Engr., Minneapolis. (8) H. C. Ahrens, Bd. of Munic. Wks., Winona.

"The Use of Activated Carbon at the Fargo Filtration Plant"
—by ORA C. AYLIFFE, Supt. of Filtration, Fargo, N. D.

The Fargo water supply is taken from the Red River of the North, usually a stream of ample velocity and flow. In the spring runoff each year, however, taste and odor characteristics may become very objectionable due to its high content of decayed vegetation. High color and high turbidity is another problem.

Coagulation with a variety of chemicals has been tried and the most effective treatment was found to be heavy prechlorination, excess lime, and chlorinated copperas. Copper sulfate has even been added to the river above the intake but amounts required for this treatment were excessive.

The drought of 1930-31 caused development of excessive tastes and odors and carbon application was started in February, 1931. When the proper point of application was learned, a carbon dose of 1.0 grain per gal. was found to give complete removal. In 1933 it was necessary to increase the carbon dose to 2 grains and in 1934-35 a dose of 3 grains proved inadequate.

However, dissolved oxygen in the river water had decreased to less than 1.0 p.p.m. An air compressor was installed and after aeration it was found that 2 grains of carbon produced a satisfactory water. More efficient application of carbon has now proven that addition of carbon at a point half-way through the settling basin makes a 1.0 grain carbon dose effective. Carbon cannot be added to the filters as it passes into and through the sand when rewashing.

River conditions have continued to become more acute. Since 1932 there have been 762 days that no water flowed over the dam at the plant intake. Hydrogen sulfide forms under the river ice, from decaying vegetation, and creates difficult conditions.

Round Table Discussion of Water Problems

This discussion was led by *R. A. Thuma,* Supt. Filter Plant, St. Paul. Unsigned questions were submitted for comment and the feature proved so popular that only those questions of particular interest can be noted here.

Elimination of red water from dead ends of mains: The use of lime with proper dosage control by pH determination to build up a protective scale, the use of chloramines when red water is due to iron bacteria, calcite beds to stabilize the water.

Copper sulfate for algae control: Dose depends on types of algae present, season of year and water temperature are important, killing of fish need not take place.

Value of underground waters in Minnesota for use in boilers: There are no waters which cannot be improved for boiler use by treatment.

Type of pipe joints most satisfactory for water mains: A wide diversity of opinion exists on this point, the advantages of lead, mechanical joints, hemp and rubber packing, being discussed at length.

The reason for renewed interest in the superchlorination process of water treatment: Taste and odor control may be accomplished more economically in this way and bacteriological disinfection to a higher degree is assured.

Financing the water department—by taxation or by sale of water: Each method has its advocates, but it appears that many city water departments certainly would be pleased to have their cities pay long overdue hydrant rental charges.

TOLEDO'S CITY MANAGER TO ITS EMPLOYEES

The following is taken from an editorial appearing in the *New York Sun,* which has many interesting aspects.

"The city manager of Toledo, Ohio, in a letter addressed to his municipal directors, commissioners and department heads, has called the attention of all classified civil service employees to provisions of the State law and the city charter which prohibit them from being candidates for public office or officers of political organizations. The same letter makes it plain that these employees are not prevented by State law or city charter from expressing themselves freely on political subjects.

What gives the letter particular interest is the word addressed to those city employes who are *not* in the civil service system. All in this group are urged by the city manager to govern themselves by the provisions which apply to civil service employees. The Hatch bill, signed by the President early in the month, presumably provided the inspiration for the Toledo letter. Provisions of the Hatch law apply to Federal employees only, but the example provided by the law apparently invites imitation.

The thoughts addressed in the letter of the City Manager to Toledo's employees are worthy of "imitation" by other cities. If municipal employees could by another Hatch law be excluded from all participation in politics, how much nearer we would be to honest, economical government and a brand of public utility operation of which many of us dream and hope for, and of which the public could proudly boast as "OUR" water, light, gas or sewerage department. As it is, these departments are too generally considered to be the politician's *first,* and the public's thereafter, be it true or otherwise.

COPPER AND COPPER ALLOYS

In Sewage Treatment

By RICHARD S. BURR
Development Engr.,
The American Brass Co.
WATERBURY, CONNECTICUT

The Author

COPPER was one of the first metals discovered by man. Likewise it was the first to be fabricated into useful articles, and to be used and distributed commercially. Today the copper group is second only to iron and its alloys in importance and usefulness.

There are several grades of copper available commercially, but the three most common varieties of refined copper are Electrolytic, Lake and Deoxidized. Electrolytic is a high purity product and is produced, as the name implies, by electrolytic refining. It is the most universally used type in this country at present. Lake Copper is a fire refined, high purity copper normally containing small amounts of silver and arsenic. The name is descriptive of the source of this type of material, which is from the Lake Superior mining district. Both of these varieties as generally used contain approximately .04% of oxygen in the form of cuprous oxide. Deoxidized Copper is free of this oxide. There are a number of deoxidizing agents and methods for handling them, but the usual practice today is the addition of very small percentages of phosphorous to the molten metal in casting.

Electrolytic vs Deoxidized Copper

Pure copper is notable for its high thermal and electrical conductivity. It is relatively soft and ductile, and may be readily worked hot or cold. It is hardened by cold working, and softened by heat treating, or annealing. Developments in welding of copper over the past few years indicate the possibility of satisfactory fusion welds with the carbon arc and the phosphor bronze or copper-silicon alloy type of welding rod. Deoxidized Copper is a more satisfactory welding material than is Electrolytic. This type of copper generally has somewhat lower electrical and thermal conductivity than Electrolytic, due to the small amounts of residual deoxidizer, although specially handled high conductivity Deoxidized Copper is available. Deoxidized Copper has certain advantages in corrosion resistance and ductility and is used generally at present for the manufacture of copper pipe and tube. All of the common varieties of copper may be readily brazed or soldered.

Electrolytic Copper is available in all commercial forms. Its most important uses are, of course, in the electrical field because of its high electrical conductivity. It is also used to a large extent for tanks and process vessels of many kinds where its corrosion resistance and thermal conductivity may be of first importance. Seamless tubes and pipes as manufactured of Deoxidized Copper are a standard product for handling domestic and industrial process water. Tinned copper pipes and tubes

Float Tubes of Silicon-Bronze
(Wards Island—N. Y. City Plant.)

have proved to be quite economical for heating coils in sewage digestion tanks. Standard pipe size or extra strong pipe size are to be preferred for this service due to the heavier wall and consequent longer life expectancy.

Copper Alloys

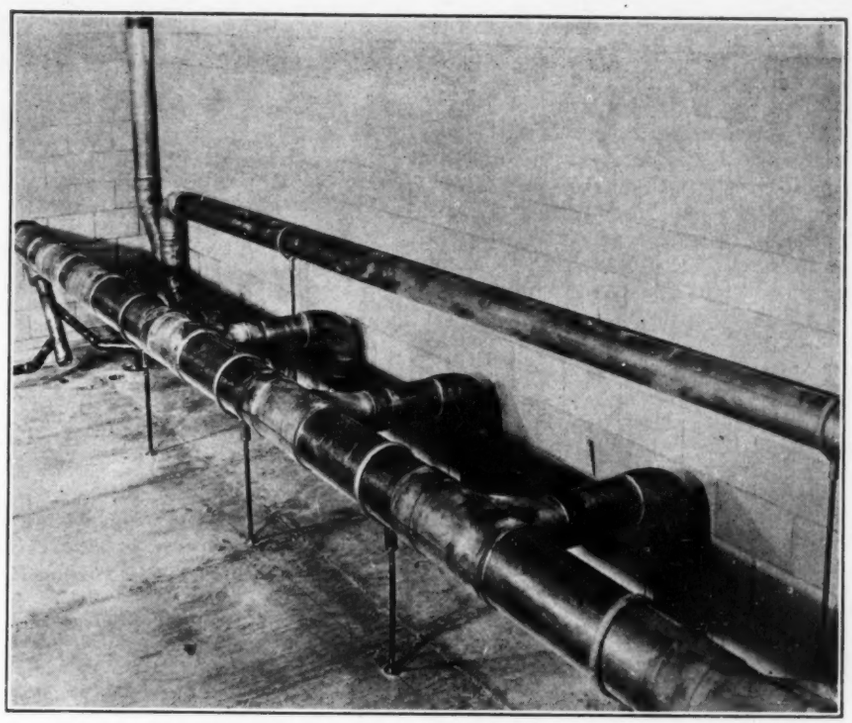
Copper alloys readily with a great many of the other elements forming several hundred commercially important copper base alloys. The brasses are the commonest and most widely used of these metals and consist principally of copper and zinc. Standard brasses are available with a zinc content up to 40%, the balance being copper. Generally speaking, the corrosion resistance of brass increases in proportion to the copper content and the strength, hardness and wearing qualities increase in proportion to the zinc.

There are a number of copper-zinc alloys modified with other elements such as tin, nickel, lead, manganese, iron, silicon and aluminum. A number of these have been traditionally known as bronzes, such as manganese bronze, in which manganese, iron and tin have been added to the high zinc brass to improve its corrosion resistance and physical properties. Lead is added to several of the brasses to improve their machining characteristics.

The copper-zinc-nickel alloys are generally white in color and are known by the trade name of Nickel Silver. These alloys have good corrosion resistance and may be easily fabricated. They are widely accepted for decorative as well as utilitarian purposes. Copper alloys readily with nickel in all proportions. Standard cupro-nickel alloys are available up to 30% nickel content. The higher cupro-nickels such as the 70 copper, 30 nickel alloy have received considerable attention in recent years due to excellent resistance to corrosion by salt water.

Bronzes

The true bronzes are essentially alloys of copper and tin. These alloys are commonly known by the name Phosphor Bronze as a small amount of phosphorous is generally used as a deoxidizer. Wrought Phosphor Bronzes are available in a number of compositions containing up to approximately 10.5% tin. Variations of the copper-tin alloys are also produced containing additional elements such as zinc and lead. The Phosphor Bronzes are notable for their high ultimate strength, yield strength, and fatigue properties, good corrosion resistance and bearing qualities. These alloys are commonly used for numerous types of springs and for bushings and bearings.



Six Inch Drainage Line in Sewage Plant at Elkhart, Ind.
(This line and others constructed of copper-tubing and cast-bronze soldered fittings made permissible a sizeable cut in plant construction costs.)

Other special alloys which have come to be known as bronzes include the Aluminum Bronzes, Cadmium Bronzes and Copper Silicon alloys.

Air Filter Such as Constructed for The Wards Island and Tollman's Island Plants of New York City
(Fabricated of "Everdur" Silicon-Bronze by American Air Filter Co., Inc.)

The Aluminum Bronzes are available in wrought forms containing less than 10% Aluminum. They are notable for high strength, hardness, and excellent corrosion resistance. They are available in suitable form for high strength shafts and valve stems and many other purposes. The Cadmium Bronzes are used principally in electrical work due to their high conductivity, strength, and good wearing properties.

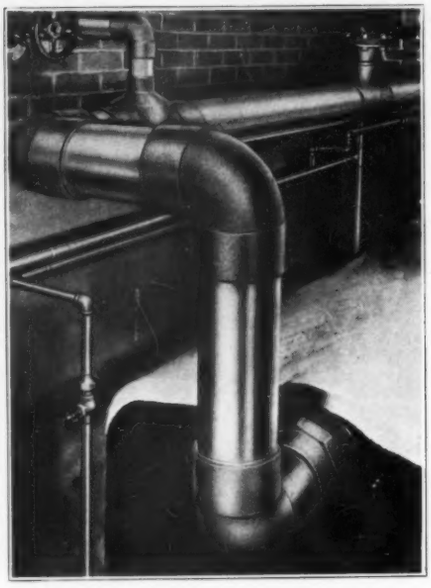
Copper-Silicon Alloys

The most important of these special alloys is the Copper-Silicon group. Because of their relatively high strength, excellent fabricating qualities, and satisfactory fusion welding properties, these alloys have come into considerable prominence as engineering materials during the past ten years. There are a number of variations in composition produced commercially but all are high copper alloys (95% or more copper) the balance being principally silicon with minor additions of manganese, zinc, tin, or iron. Lead is also added in small quantities in the case of rod stock where free machining is important. The corrosion resistance of these alloys is equal to pure copper, and in some extreme cases superior. They possess relatively high strength, having a minimum tensile strength in the soft or annealed condition of 50,000 lbs. per square inch ranging up to 100,000 lbs. per square inch in certain cold worked forms. They are highly resistant to fatigue and are available in alloys which may be readily hot or cold worked. Most commercial forms of mill products, such as wire, rod, sheet, plates, tubes and shapes, are regularly produced, and many fabricated items such as bolts, screws and other hardware are available from leading manufacturers.

Importance in Sewage Treatment

The copper-silicon alloys have been used extensively in the sewage treatment field over the past twelve years with uniform success. Some of the earliest applications were the use of hot rolled plates for gates, baffle plates, weirs, screen plates and other similar parts. Rods formed to the proper shape have proved to be very satisfactory for manhole steps. Floor and stair treads and gratings are also available.

The non-magnetic properties of these alloys have led to their use in magnetic filters. Considerable quantities of expanded metal and other items of copper-silicon alloys have been used in the past two or three years in the construction of air filters. Many of the largest plants in the country, as well as the smaller installations, have made extensive use of these very versatile metals where durability and resistance to corrosion were required.

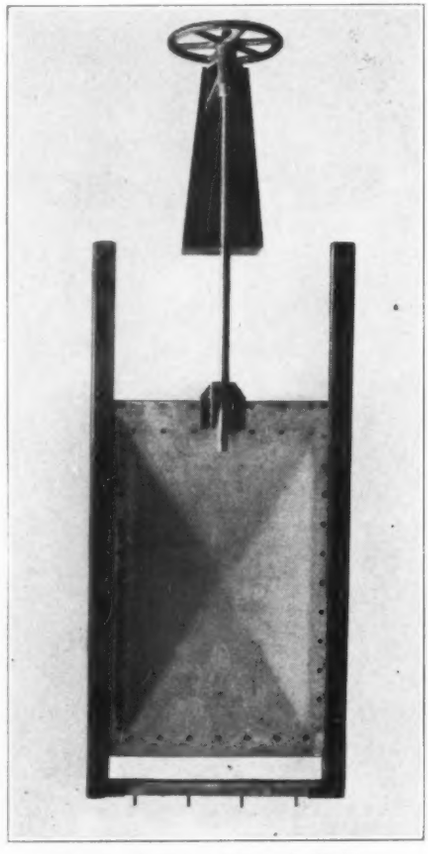


Hot Water Recirculating System
(Type "K" copper tubing and cast-bronze soldered fittings.)

The sewage treatment field has been expanding quite rapidly over the past few years and new developments therein have meant new problems for the producers of construction materials.

Corrosion problems in handling sewage are numerous and varied in character. It has been necessary for the manufacturers of corrosion resisting metals to work very closely with the engineers and operators of sewage treatment plants, as the answer to a particular problem is often one which cannot be definitely determined in the laboratory, but must be based on actual service experience. Early tests of the copper-silicon alloys have led to their extensive use today as discussed above. Tests which are under way at present may indicate other economical metals and applications.

Tests of copper and copper alloy pipe materials for handling sludge gas are going into their third year. At the end of the second year, Admiralty Metal (Copper 70%, tin 1%, zinc 29%) and tinned copper showed practically no corrosion and were in the best condition of all samples tested. The cooperation of those in charge of sewage treatment plants in connection with such experimental work is greatly appreciated and the information thus gained should be of great value to both operators and manufacturers.



Standard Type "Everdur" Gate
(Manufactured by Krajewski-Pesant Mfg. Co.)

GREENVILLE, S. C. MODERNIZES ITS SEWAGE PLANT

By-product Power Development, Incorporated

In the modernization and enlargement of the Sewage Treatment Plant of Greenville, S. C., power development from digester gas constitutes a part of the project.

The two (twin) engines will be Cooper-Bessemer four cylinder units rated 225 horse-power (each) at 450 r.p.m. Direct connected will be two G.E. 150 K.W. Generators. For maximum dependability, the engines will be equipped with dual ignition systems, which include twin magnetos, two complete sets of spark plugs and double wiring.

Since the Greenville plant receives a large proportion of its solids from the mills of the city, which solids contain much starch and other organic materials, the yield of gas at this plant is at a level so high as to make power generation with gas engines doubly attractive. Engineers on the project are J. E. Sirrine & Co., of Greenville; contractors are V. B. Higgins Co. of Greensboro.

SEWER SERVICE AND MAINTENANCE

As Practiced by the Joint Meeting—Featuring a Radio Equipped Service and Maintenance Truck

By EDWARD P. DECHER
Ass't. Secretary and Purchasing Agent
THE JOINT MEETING
NEWARK, N. J.

IN accordance with the request of the editor of this magazine it is a pleasure to give to the readers of WATER WORKS & SEWERAGE some information pertaining to maintenance practice, safety measures, and equipment employed for both, by the Joint Meeting.

First, it should be explained that the Joint Meeting is a Sewer Commission and is comprised of the following eleven municipalities: City of East Orange, Town of Irvington, Township of Maplewood, Township of Millburn, City of Newark, Village of South Orange, and the Town of West Orange, all being in the County of Essex. In the County of Union are the Township of Union, Township of Hillside, Boro of Roselle Park, City of Summit.

The Joint Trunk Sewer—

The Joint Trunk Sewer is constructed within the boundaries of the aforementioned municipalities. The original sewer was built in the year 1900 and is approximately 23 miles in length. A Supplementary Joint Trunk Sewer was completed in the year 1930 to give a total of 54 miles of main trunk sewer in all.

The Joint Trunk Sewer at the present time is serving an estimated population of about 305,000. The Sewage Treatment Plant is located in the City of Elizabeth, the final effluent discharging into Arthur Kill. One can readily see that should our men and equipment be working in the Town of West Orange and an emergency should arise in the Boro of Roselle Park or at our Treatment Plant (the plant being about 12 miles from the Town of West Orange) a difficult task would be encountered in contacting the men or securing needed equipment.

Our Truck Now Radio Equipped—

Because of the distances involved it was deemed advisable by the Hon. Peter A. Smith, Chairman of the Joint Meeting, to equip one truck, at least, with a short-wave receiving set for the purpose of reaching our maintenance and service crew in the shortest possible time in case of an emergency or a complaint received which justified attention with least delay.

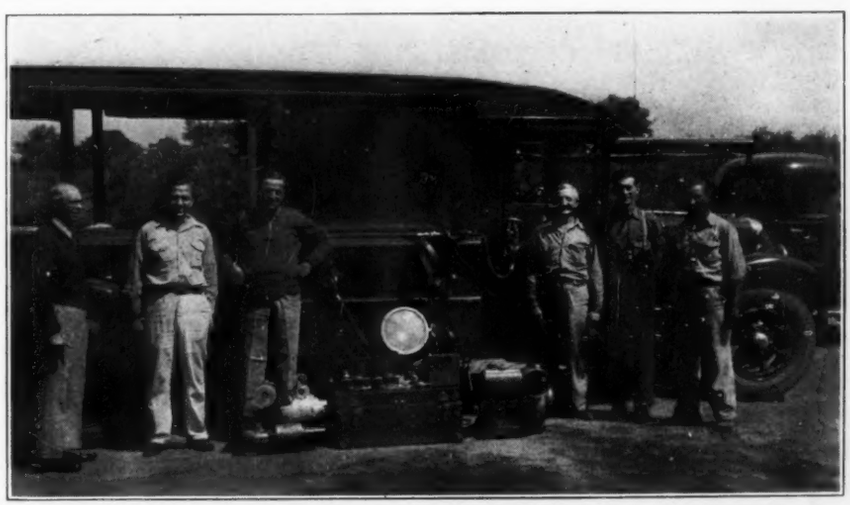
The Author

The radio set was purchased at a cost of $170.00. Through the courtesy of Mayor Ellenstein and Hon. Michael P. Duffy, Director of Public Safety, both of Newark, the set was installed free of charge and the broadcasting of our messages for equipment or men is also granted to the Joint Meeting by the City of Newark without cost. This set was installed on our three ton International truck and placed in operation on Monday, October 10th, 1938.

The following is a list of the equipment carried on our two motor trucks.

1 Hydrogen Sulfide Detector.
1 Wolf Safety Lamp.
1 Combination Velocity Blower Hose Mask with Safety Harnesses.
1 Carbon Monoxide Detector.
2 Canister Type Gas Masks. Carbon Monoxide Detector Ampoules.
2 Pairs Chippers Goggles.
1 2½" Portable Air Blower.
1 Combustible Gas Indicator.
1 Industrial First Aid Kit.
4 Extra Safety Belts with ropes attached. Salt tablets for use in the prevention of heat sickness.
1 1500 Watt Portable Electric Generator and Floodlights.

The Joint Meeting has six employees on General Sewer Maintenance (see photo No. 1) and all of these men have taken a course in First Aid which course was given by the Newark Safety Council. Besides being capable of administer-



No. 1—Radio Equipped Maintenance and Service Truck and Equipment
(Henry Decher, Ass't. Foreman (left) and Crew)

ing first aid, all of the men are trained in the proper use and operation of the many safety devices carried on our equipment at all times.

Our men are especially instructed in the use of the hose and canister type masks. The Joint Meeting will not permit any of its men to enter a sewer or any sub-surface structure with a *canister* type mask which is of no value in oxygen deficient atmospheres. All of the above-mentioned equipment is inspected and tested at regular intervals. The Joint Meeting has another truck which is equipped with practically the same equipment as outlined above. However, no radio has been installed on this truck up to the present time.

All of the equipment owned by the Joint Meeting is available at all times to any municipality if needed and can be obtained on short notice by sending a call to the Newark Police Department from where the message is dispatched by radio to our men on the truck.

We have heard of water service trucks that have been radio equipped. However, at the present time, I know of no other sewer truck equipped the same as the one owned and operated by the Joint Meeting, and I believe that it is the first sewer truck in the United States equipped with radio. (So far as we are aware, such is the case. If there are other radio equipped sewer service trucks in the United States which were in service prior to Oct. 10, 1939 we shall be glad to hear of such and will run a correction; also a picture of the truck if submitted.—Ed.)

In photograph No. 1 is seen the two maintenance trucks (the larger being the radio equipped unit), some of the equipment listed above, and the General Maintenance Crew. From left to right Henry Decher, Ass't. Foreman, Richard Goulden, Alfred Mulford, Harry Burgesser, Alfred Manteria, Frank Elacqua.

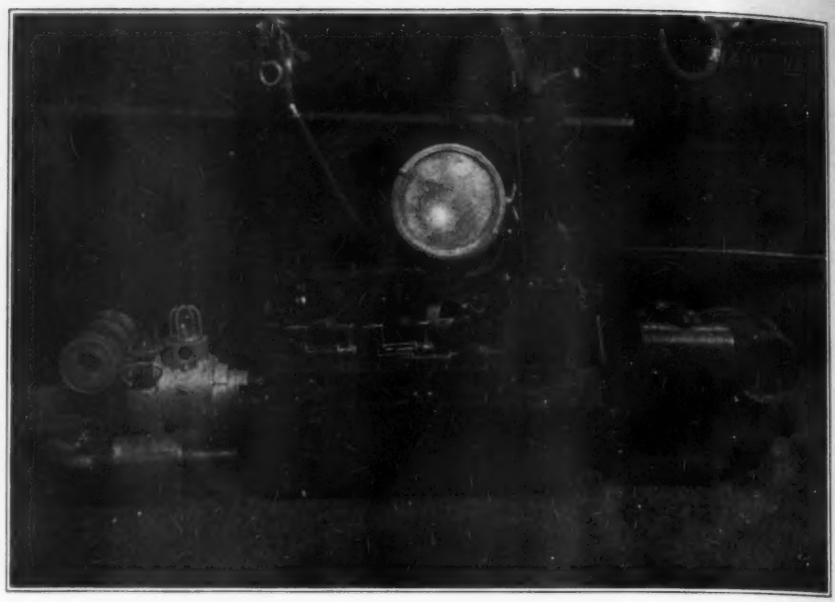
—*Equipment*—

In a photograph (No. 2) taken closer up is seen several of the more important items of equipment.

Portable Generator—

On the left is our indispensable Homelite Portable Generator good for 110 volts D.C. and 1250 Watts. In center, the flood-light. Both are products of the Homelite Corporation of Port Chester, N. Y.

With this generator we have several electrical tools and flood lights. These electrical tools have been found to be very satisfactory. We have never at any time found ourselves without proper lighting when emergency work is performed at night. We have approximately 200 feet of special extension cord, should the necessity ever require special lighting in our large sewers when repairs are made. A good portion of our sewers are in outlying territory where electric current to be supplied from a nearby house is impossible.



No. 2—Some of the Equipment
(See text for description and uses)

It may be interesting to note that the Joint Meeting has two cast iron pipe sewers, one being 36 inches in diameter and the other 54 inches, which run parallel and lie on the top of the ground in the Township of Union and each being approximately 1500 feet in length without any manholes. It has been recommended by the Chief Engineer—Leslie E. West—that at least four manholes be built on each line and the type recommended are Hat-Flanges, with bolted covers. To install these Hat-Flanges our portable generator will play a very important part, that is for furnishing the current to drill the necessary holes in the present pipe in order to fasten on the Hat Flanges. If it were not for this machine it would require drilling these holes by hand or renting the equipment.

On two occasions power failures were encountered at the Treatment Plant. We were able to supply the necessary light until the current was restored. Our generator has proven a very sound investment, if not an indispensable one.

No. 3—We Find the Flexible Rod to Have Many Advantages
(Looking into the manhole are Henry Decher, Foreman, and (right) Corey W. Sanford, Sup't. of Sewers.)

Blower, Hose Masks and Gas Detectors—

The next item in this photograph is the trunk like case which contains the blower and the hose type gas masks. This piece of equipment is manufactured by the Davis Emergency Equipment Company, Inc. of New York City. On the top of this case are two carbon monoxide detectors, two hydrogen sulfide detectors and one combustible gas indicator. The last two items of equipment are products of the Mine Safety Appliance Co. of Pittsburgh, Pa.

Portable Air Blower—

The last item in this photograph is the portable air blower (on the right) manufactured by the B. F. Sturtevant Company of Boston.

This piece of equipment has proven very satisfactory and is used in ventilating sewers before men are allowed to enter. It has also been used at our Treatment Plant in drying out the tunnels. There also appears on this photograph, hanging from the side of the truck, the headpieces and safety belt of the gas mask. This equipment as shown is carried at all times with the necessary First Aid equipment on this truck. A combustible gas indicator manufactured by the Davis Emergency Equipment Co., together with the duplication of the carbon monoxide and hydrogen sulfide detectors are carried on our other truck, and another set is stationed at our Treatment Plant,

The Commissioners of the Joint Meeting insist on a careful study being made at all times before any equipment of this type is purchased so that the best available is obtained. It is the opinion of the writer that no municipality can afford to be without the necessary safety equipment for the protection of their employees. While the cost of the aforementioned equipment is most reasonable, it is priceless in the event of an emergency.

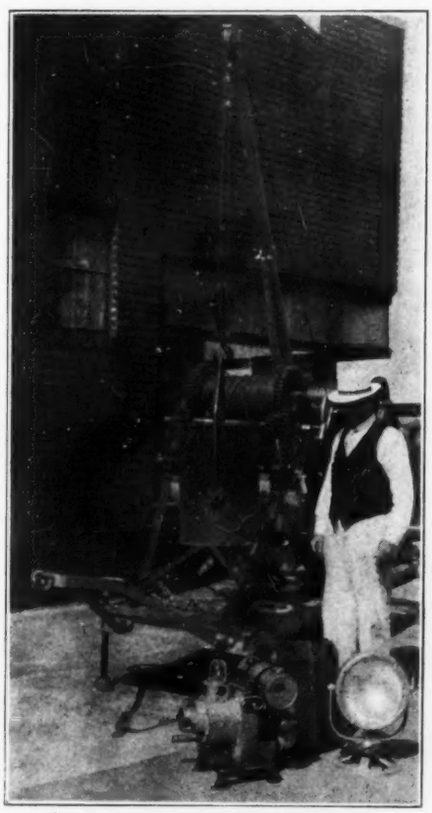
Flexible Sewer Rods—

The Flexible Sewer Rod shown in photograph No. 3 has proven to be a very satisfactory piece of equipment. This piece of equipment, manufactured by the Flexible Sewer Rod Co. of Los Angeles has many advantages, such as can be seen. One can readily understand that the old method used in removing an obstruction in a sewer that only one man could placed in a manhole, in a cramped position, at a time, thereby reducing his strength to a minimum when working. With a flexible sewer rod you can notice in the photograph that more than one man can be used and greater pressure exerted, and the safety feature is that the men are on top of the ground at all times during this particular operation. We have found that an obstruction can be moved much faster with this piece of equipment than the methods used here-to-fore, and that more territory can be covered in a shorter time. There are also many other advantages.

Portable Derrick—

The portable derrick shown in photograph No. 4, manufactured by The G. J. Pollard Company of Brooklyn, N. Y., is known as the Pollard Portable Platform Derrick. The platform on this derrick is large enough to transport our two Turbine Sewer Cleaning Wenches (Turbine Sewer Machine Co. of Milwaukee) with the drum and cables intact.

These wenches, with the drums and cables, are rather heavy but can be easily placed on the derrick platform without much effort, due to the fact that the platform is only 12 inches above the ground. This platform derrick is equipped with a set of small rubber wheels in the center, and is towed on the rear of our truck from one job to the other.



No. 4—Pollard's Portable Platform Derrick
(On the platform a turbine wench; Sup't. Sanford, Portable Homelite Generator and Flood Light.)

The derrick has a lifting capacity of 1000 lbs. and can be swung in any position desired. It has been used to lower pipe on some of our repair jobs, and used in raising tilting buckets out of manholes during sewer cleaning operations. It has also been used very successfully in loading heavy manhole heads and pipe on our truck, therefore making loading much safer. This piece of equipment has proved highly useful.

Rescue and First Aid Practice—

Photographs No. 6 and No. 7 show our employees giving a demonstration of the proper method of rescuing a man, should he be overcome while working. There may be a possibility that the reader seeing this photograph may criticize the fact that we permitted a man to enter a sewer or chamber without the proper equipment, however, this is not the case with the Joint Meeting. I believe, though, that the fact can be appreciated that it is a hard task to have a man working in a sewer wearing a gas mask continuously, if the conditions under which he is working are absolutely safe. Extensive tests are made before any man is permitted to enter any of our sewers. We have quite a number of meter chambers which are far above the sewer line itself. These must be entered by our employees each week to change the meter charts, and in performing this duty it is not always necessary for a man to be equipped with a mask if conditions are safe, however, one can never tell when an employee may be suddenly attacked by some gas. For this reason our employees must go through a rehearsal such as pictured, so that they do not lose their technique and ability in case of an emergency.

Compensation Insurance—

The Joint Meeting carries compensation insurance, which we believe is very necessary. Regardless of how minor an injury may be, even to a small scratch on the finger, the employee must go to a doctor for the necessary treatment. This is to insure their safety and to minimize claims against the Joint Meeting.

Last year all of the employees of the Joint Meeting were inoculated against typhoid fever. This was paid for by the Joint Meeting as a safeguard to its employees. The Joint Meeting makes every effort to see that its employees are protected from any hazards and makes it a

practice to have a safety engineer from the insurance company make regular inspections of the equipment and Treatment Plant every month. And, at the same time the inspection is made a safety meeting is held by our employees, they having an opportunity to discuss problems pertaining to the plant with the safety engineer.

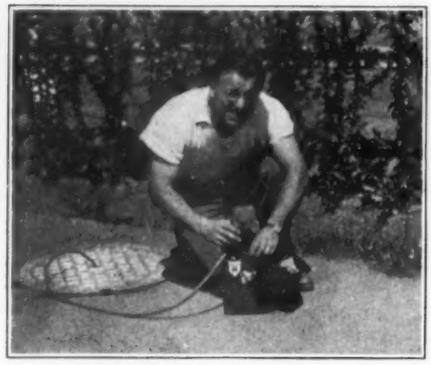
Safety Equipment Demonstrations—

In June, 1938 the Commissioners of the Joint Meeting held a special meeting at the Treatment Plant for the purpose of gaining as much knowledge as possible for themselves and the employees on safety measures. The principle speakers at the meeting were Mr. E. M. McCool of the Mine Safety Appliance Co., and Mr. L. W. Brendlen of the Davis Emergency Equipment Co. They gave a very splendid lecture and demonstration on the proper uses of the various safety devices used in connection with sewer work. This meeting was attended by approximately 100 officials connected with the municipal sewer departments in Essex and Union Counties, New Jersey.

The Commissioners of the Joint Meeting exert every effort to see that this sort of thing is carried on and it has proven to be very profitable for the safety of all concerned.

Employee Suggestion-Box and Prize Contest—

There is installed on the wall in the Treatment Plant a box known as the Suggestion-Box in which suggestions are deposited by our employees. Employees have continuously placed suggestions in this box and, after being given careful consideration, the most practical are tried. A number of the suggestions submitted have been found to be decidedly beneficial. It is a commonly known fact that men in constant contact with equipment are those most able to express its advantages and observe wherein improvements would bring about better results. The Commissioners of the Joint Meeting have discovered that many of these suggestions have resulted in a considerable saving in dollars. For this reason the Commissioners of the Joint Meeting have set up two prizes for a contest which is now in progress, giving each employee an opportunity to express his views as to what in his opinion would better serve the Joint Meeting as operation of the Treatment Plant, maintenance of the sewers, safety of the employees, or any other item pertaining to the works in general.



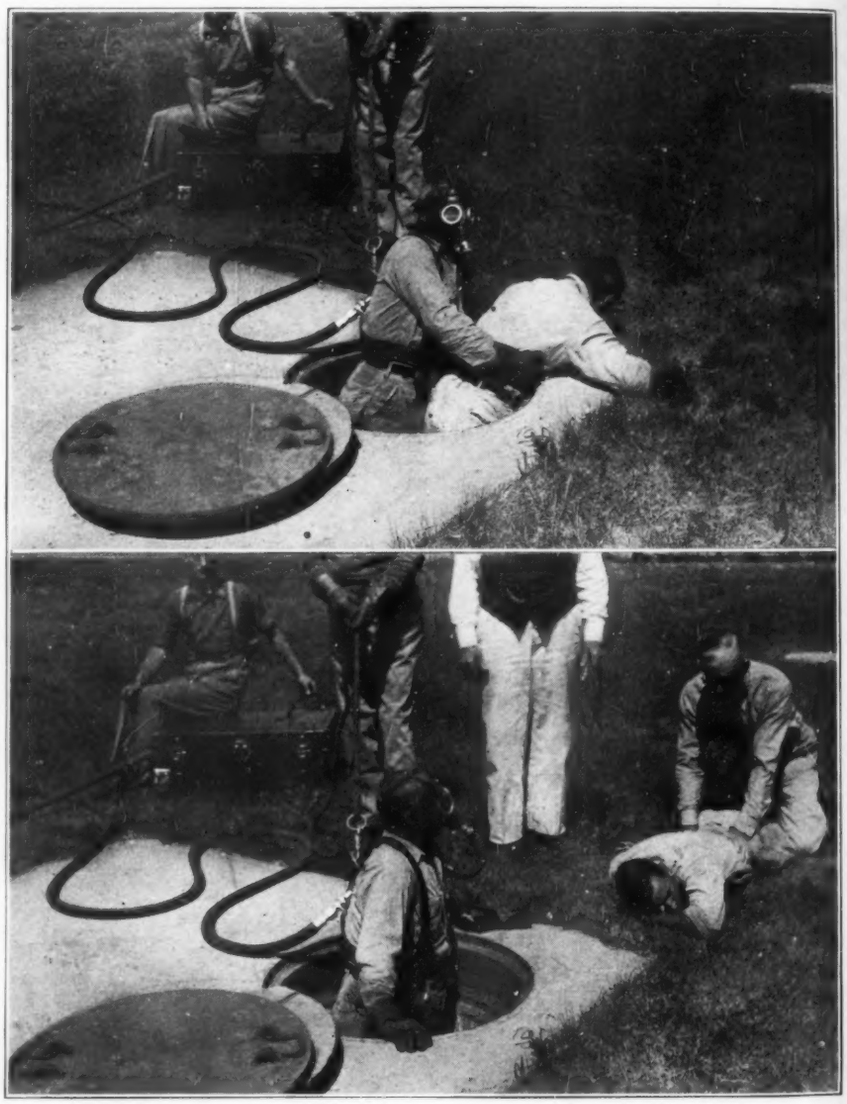
No. 5—Our Chief Engineer, Leslie E. West, Demonstrates the Test for Poisonous and Combustible Gases

An Invitation—

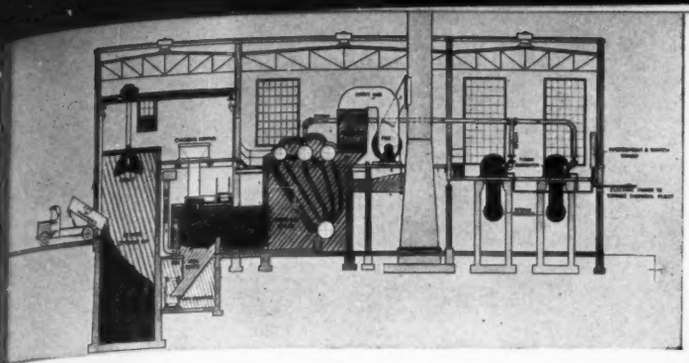
We would like to take this opportunity to extend to the readers of WATER WORKS AND SEWERAGE an invitation to attend one of the meetings of the Joint Meeting which are held on the first and third Thursday of every month at 3:00 p.m. at the East Orange City Hall. I believe that you will be very much surprised to see the interest, activity and the cooperation of our Commission composed of the following as members:—

Peter A. Smith, Chairman
Frank A. O'Connor
J. Edward Jacobi
Clarence A. Hill
Thomas W. Bennett
Frederick C. Rauch
Harry Schnabel
Milo S. Borden
Meyer C. Ellenstein
G. Harry Cullis
Benjamin Romano

The Joint Meeting has been most fortunate, since its inception, in not being faced with any serious accidents and this can all be attributed to the thoughtfulness, foresight and the capable leadership of our Chairman.



Nos. 6-7—Rescue and Resuscitation Practice Is a Requirement by the Joint Meeting



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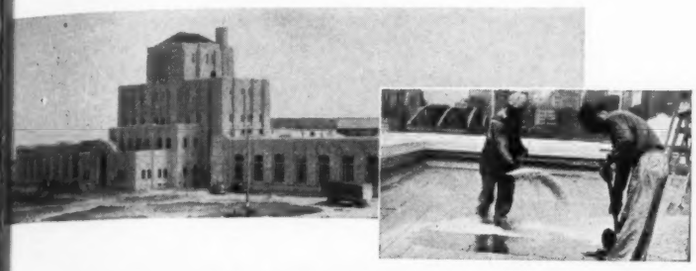
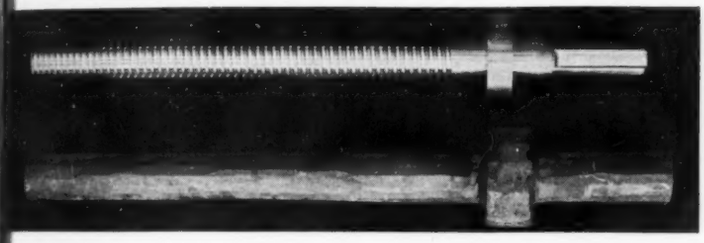


KOPPERS ROOF WILL GIVE MAXIMUM LIFE ON THIS FILTRATION PLANT. Koppers Coal Tar Pitch and Tar-Saturated Felt were chosen for the flat roofs of this Filtration Plant. The longest service life records have been made by roofs of coal tar pitch. It resists both water and sunshine.



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Ult. T. S.	115,000 #/sq. in.
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Elong. in 2"	12%
Red. of Area	12%
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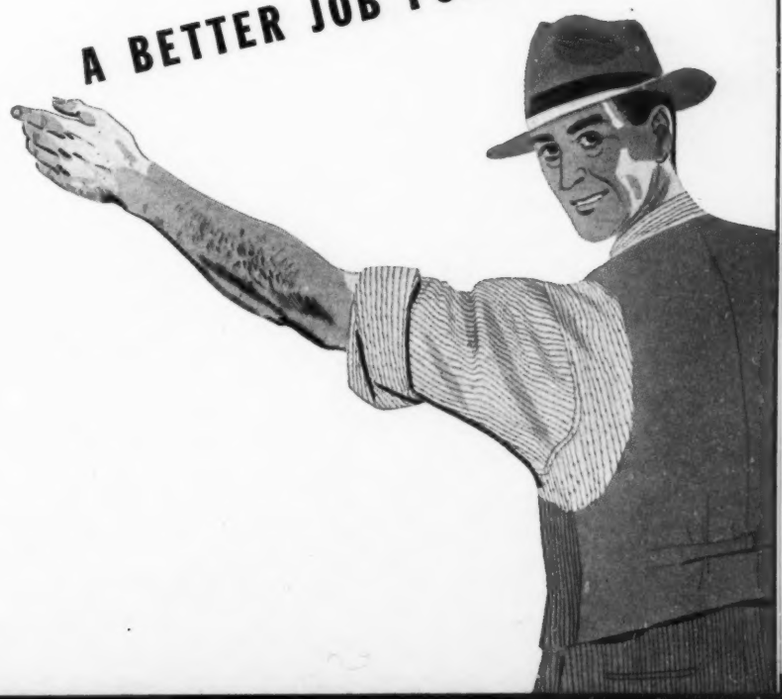

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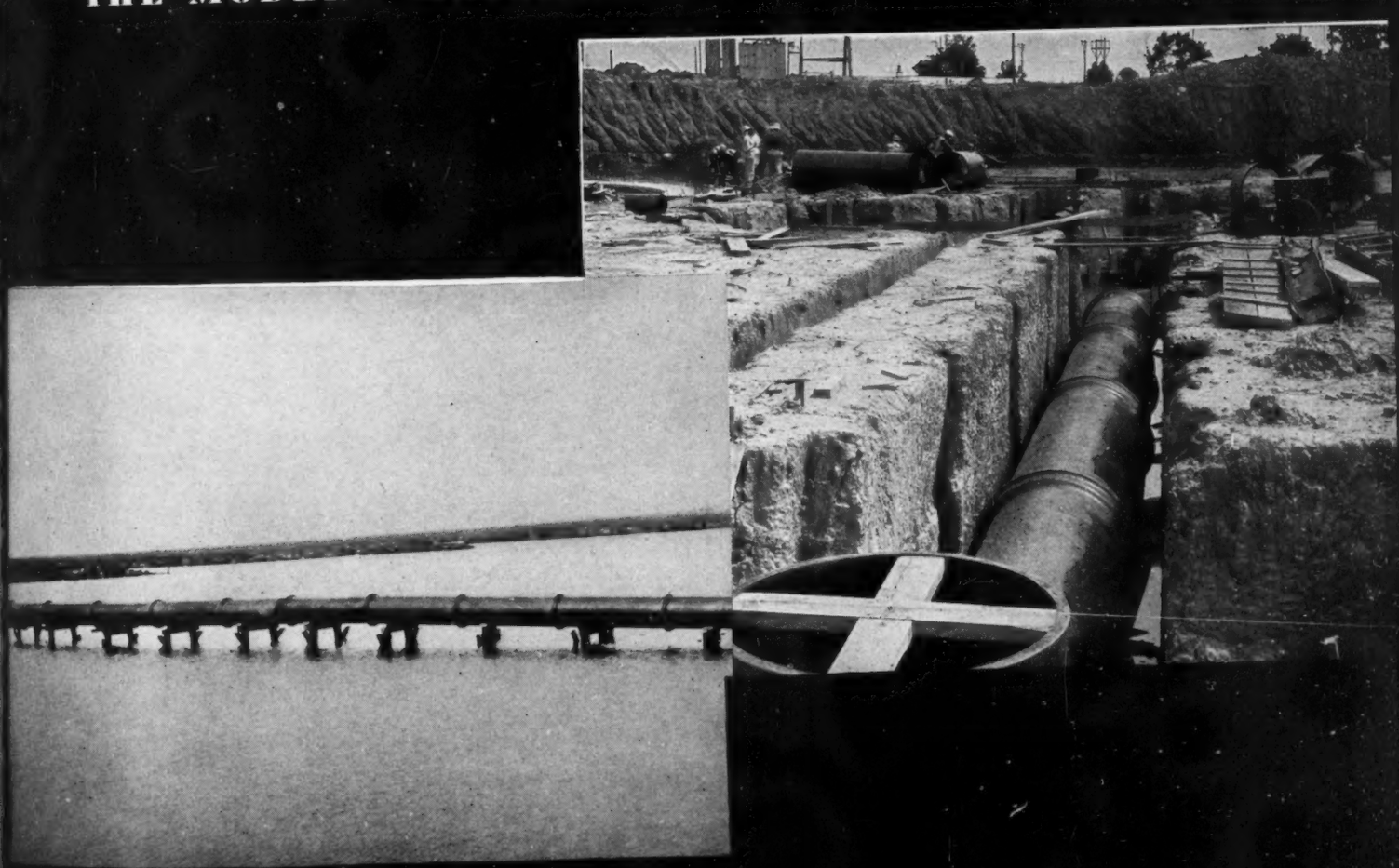

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UNIQUE SOLUTION FOR GRIT CHAMBER DESIGN

Employed in the Modernization of the Plant of Lakewood, Ohio

The Author

By GEORGE E. BARNES*
Consulting Engineer,
CLEVELAND, OHIO

A UNIQUE solution for grit chamber design is incorporated in the sewage treatment plant improvements for the City of Lakewood, Ohio. The design comprises (1) a control section of novel type at the outlet end of the grit chambers, providing for the self-regulation of grit chamber velocities over the full range of discharge; (2) a simple means of flow measurement and recording, based on the outlet control section dimensions which fix the relation between water surface elevations in the grit chamber and the rate of discharge.

Incident to design and construction of this unit the control section rating curves were determined prior to construction, by means of a hydraulic model study, in order to furnish accurate data for the precise design for the raw sewage meter installed in the plant. The basic principles employed in the design are generally known to hydraulic engineers. However, the method of analysis and its direct application to the problem at hand, while used by the writer some years ago,** is not widely known.

In view of the frequent recurrence of the grit chamber design

* Head, Department of Civil Engineering, Case School of Applied Science.

[** The Manhattan and Bronx grit chambers of the Ward's Island Project were designed by the author (1932) by similar analysis. Model studies on this work are briefly described in his article "New Functions for the Hydraulics Laboratory," in **Water Works and Sewerage**, for September, 1936, p. 360.—Ed.]

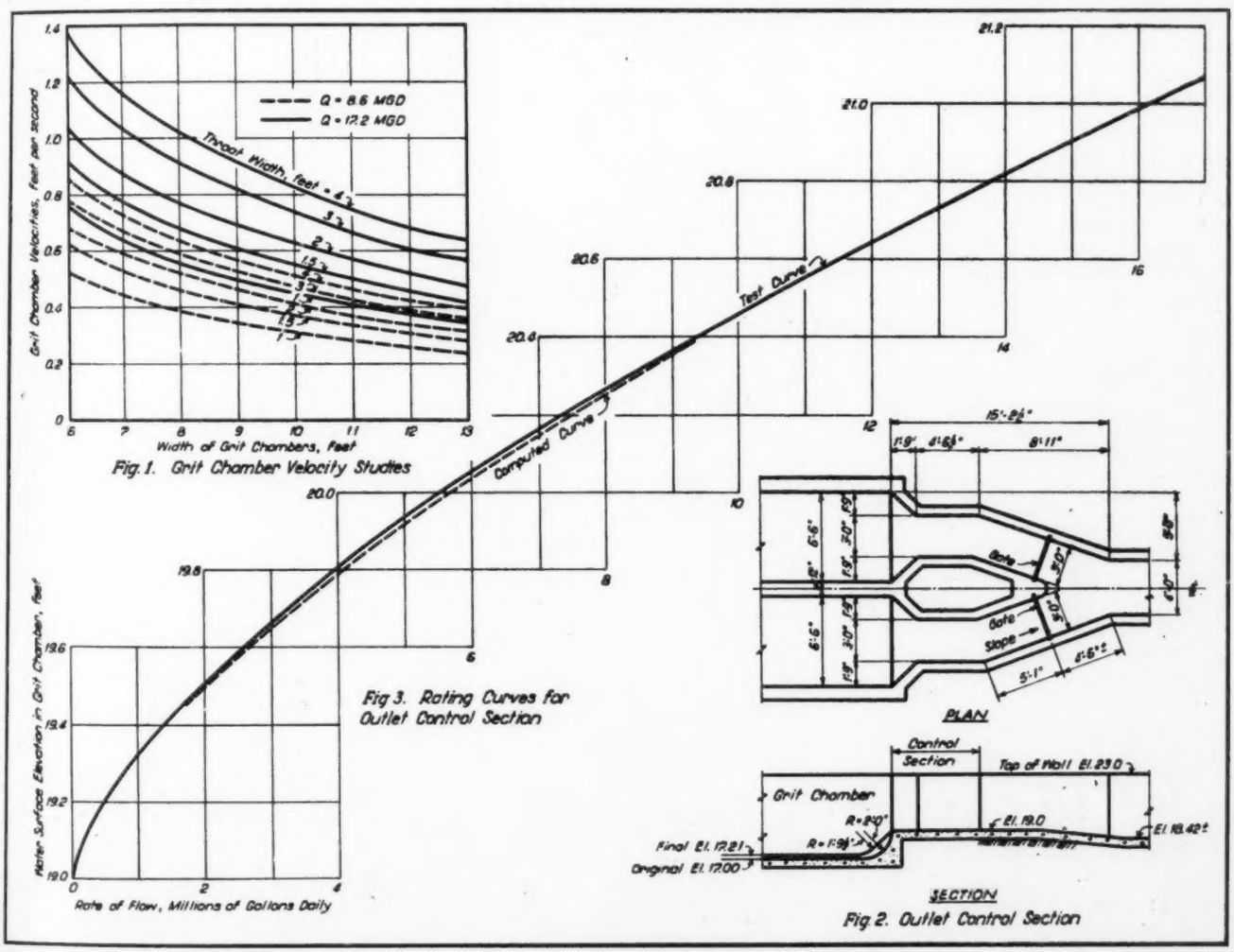


Fig. 1. Grit Chamber Velocity Studies

Fig 3. Rating Curves for Outlet Control Section

Fig. 2. Outlet Control Section

Fig. 1 (Upper Left) Curves Developed in Design for Velocity Control in Grit Chamber
Fig. 2 (Lower Right) Dimensions of Outlet Control Section Adopted for Lakewood.
Fig. 3 (Center) Rating Curves for Outlet Control Section—Computed vs. Observed.

problem, and in view of the many expedients employed for the control of velocities, or for the measurement of discharge, or both, a full description of the Lakewood design will be of interest. [Also in this same issue the general improvements to the Lakewood plant are presented by Rollin F. MacDowell, Consulting Engineer.]

Features of Old Lakewood Grit Chambers

In the existing plant, which has served Lakewood from 1916 to date, raw sewage is delivered to a riser well, which has two spillway weirs, one feeding the plant, and the other the storm water overflow line. The spillway weir to the plant serves as a crude measuring device for the raw sewage flow. The sewage passes through racks to twin grit chambers of the rectangular flume type, from which the grit is removed by grab buckets. From the grit chambers, the sewage flows through a header channel to Imhoff tanks. Water surface level in the grit chambers is controlled by the Imhoff tank effluent weirs, and is practically constant. To compensate for the wide variation in grit chamber velocity, as the flow varies, or to secure optimum average velocities under these circumstances, means were provided for varying the effective cross-sectional area of the grit chambers. This was done by the adaptation of adjustable steel sidewalls, hinged to swing in a vertical arc, so that the grit chamber flow compartment could be made similar in shape to the flow compartment of an Imhoff tank. The sloping bottom is varied by manual operation. When not in use, these sidewalls are swung back into recesses in the concrete.

In the design of the new units, it was, of course, desirable to utilize existing structures to the fullest extent. It was necessary, however, to greatly improve the performance of the grit chambers, to install mechanical screenings and grit removal equipment, and to provide an accurate raw sewage meter. The greatest limitation on design was the small amount of available head between riser well and the Imhoff tanks. The original grit chamber walls were incorporated in the new structures.

Characteristics of Control Section

Considering the limited head available, and the probable cost of installing alternate types of flow measuring devices, the selection of a control section was logical at Lakewood. In open channel flow, a control section is one at which the minimum energy gradient for any discharge is independent of the downstream gradient. Unsubmerged broad crested weirs, unsubmerged Venturi flumes, and the Parshall flume (which is a special form of Venturi flume), are familiar examples of control sections. A *properly designed control section* has the following advantages in measuring sewage or debris-laden water:

1. accuracy
2. initial rating is permanent
3. non-clogging
4. small loss of head
5. performance independent of tailwater level, within wide limits
6. simplicity and low cost

These advantages may be possessed by a great variety of forms of control sections. They are possessed by the Parshall flume, for example, which is a well known form. It is worth noting, however, that they are not possessed by the Parshall flume to the exclusion of other forms, although from review of the literature it appears that this impression is erroneously held by many engineers who do not have a critical appreciation of Parshall's excellent development work, in which he calibrated several special forms of control sections.

Purpose of Control Section

In the case of Lakewood, flows are expected to vary from 2.0 MGD to 18.0 MGD, with normal flows at from 6.0 to 8.0 MGD. At very low flows, the grit load will be negligible, and it is necessary to provide only against the deposition of the lighter organic matter. For higher flows, carrying grit, it was decided to limit the velocities from a minimum of 0.6 ft. per second to a maximum of about 1.1 ft. per second, increasing with the rate of discharge. With mechanical removal of grit, experience indicates that these limits will be satisfactory. The purpose of the control section is twofold, namely:

(1) To provide suitable velocities in the grit chamber, by maintaining a depth in the grit

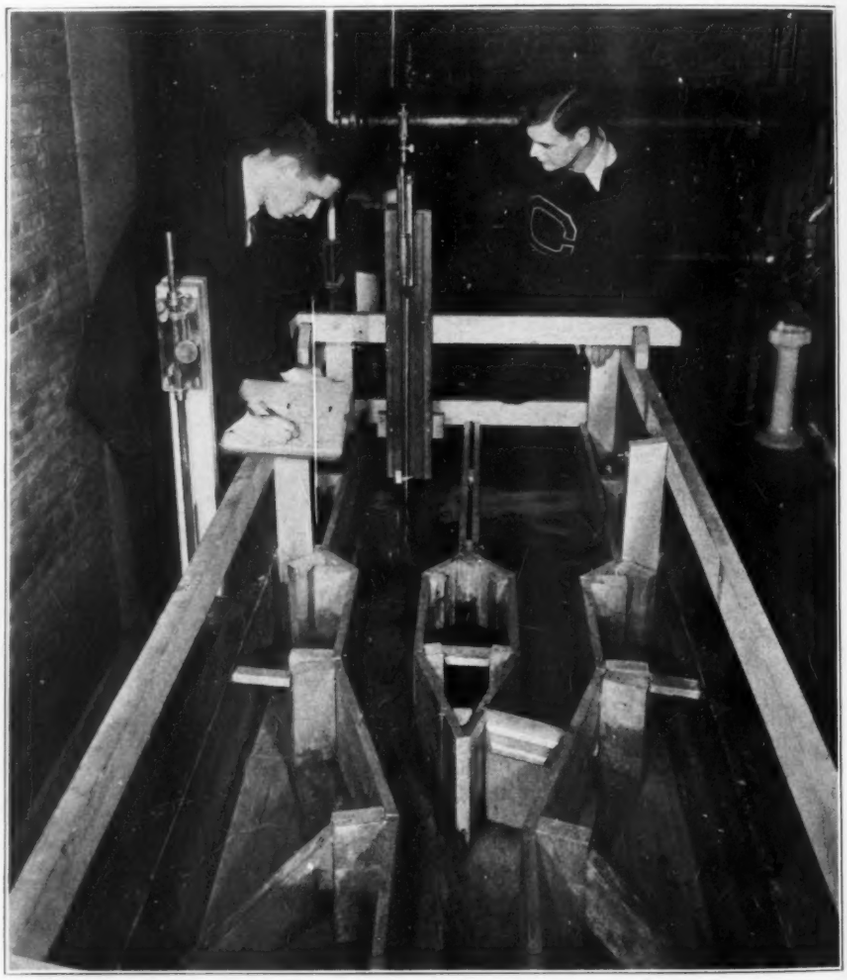


Fig. 4—Model of Grit Chamber Control Section—Under Test in the Warner Hydraulic Laboratory, Case School of Applied Science. (In the picture are W. H. McClarran, graduate assistant, left, and Carl A. Carlson, civil engeneering senior.)

chamber which varies within proper limits with respect to the rate of discharge.

(2) To provide a sensitive means of measuring the rate of discharge, by establishing the relation between discharge and water surface elevation.

The success of the design depends on properly proportioning the structure for these dual purposes; a successful design for the one being not necessarily a successful design for the other.

[Note:—The control sections described in this article were designed by the writer who was consulting engineer to Rollin F. MacDowell on this feature of the Lakewood plant. All patent rights pertaining to the design of settling basins, including grit chambers, by the principles and methods shown, and for the purposes stated, are reserved by the writer.]

Selection of Dimensions for Control Section

While a variety of cross-sectional shapes for grit chambers and control sections may be analyzed by the methods shown herein, the writer has limited the discussion to rectangular shapes, which lend themselves to the use of competitive types of grit removal mechanisms, which are the simplest to design and build, and which work out satisfactorily for ordinary cases. By the proper selection of grit chamber width and depth and control section width or depth, in relation to the range of discharge to be handled, it is possible within practical limits to govern the average velocity in the grit chamber. The method of calculation is shown later.

In the Lakewood case, studies were made for a series of designs, in order to select one which was suitable. The result of these studies is shown in Fig. 1—"Grit Chamber Velocity Studies". The velocity in the grit chamber is taken as the rate of flow divided by the product of grit chamber width, and depth; the depth being figured from water surface to six inches above the floor, which allows for the space occupied by the grit collector flights. This might be called the "effective floor elevation", which in the case of Lakewood was assumed to be Elev. 17.50, in design. It agrees quite closely with the elevation finally adopted upon selection of grit collector equipment. Fig. 1 may be read as follows: With Q = 17.2 MGD., width of grit chamber 6.5 ft., throat width 3.0 ft., the velocity in the grit chamber will be 1.11 ft./sec. With Q = 8.6 MGD., the velocity will be 0.72 ft./sec. The dimensions of the control sections adopted for Lakewood are shown in Fig. 2—"Outlet Control Section".

Preliminary Calculations on Rating Curve

The relation between water surface elevation in the grit chamber, and the rate of discharge, or the rating curve, was calculated as follows:

Let Q = rate of discharge, c.f.s.
d_c = critical depth, in ft., at the control section
b = width of control section, ft.
V = velocity in grit chamber, ft./sec.
v = velocity in ft./sec. in control section, at critical depth
g = acceleration of gravity, ft./sec.^{2}
19.00 = Elev. of floor of control section.

Then:

Elev. W. S. in grit chamber

$$= d_c + (1+k)\left(\frac{v^2 - V^2}{2g}\right) + 19.$$

with the low velocities in the grit chamber, the value of $\frac{V^2}{2g}$ may be considered negligible, whence,

Elev. W. S. in grit chamber

$$= 19. + d_c + \left(\frac{1+k}{2g}\right)\left[\frac{Q}{b\,d_c}\right]^2$$

Where (for a rectangular channel) $d_c = \sqrt[3]{\frac{Q^2}{gb^2}}$ and b = 3.0 in this case.

∴ Finally:

$$\text{W. S. Elevation} = 19. + \sqrt[3]{\frac{Q^2}{gb^2}} + \frac{1+k}{2g}\left[\frac{Q}{3.0\,d_c}\right]^2$$

On the basis of experience with similar structures and tests, the writer assumed k = 0.10, and computed the water surface elevation in the grit chamber for various rates of flow, in accordance with Table A, below:

The rate of flow shown in this table is for one of the two grit chambers in operation.

If two chambers are operated simultaneously (which is not contemplated), all figures in the table would remain the same, but the flow would be doubled.

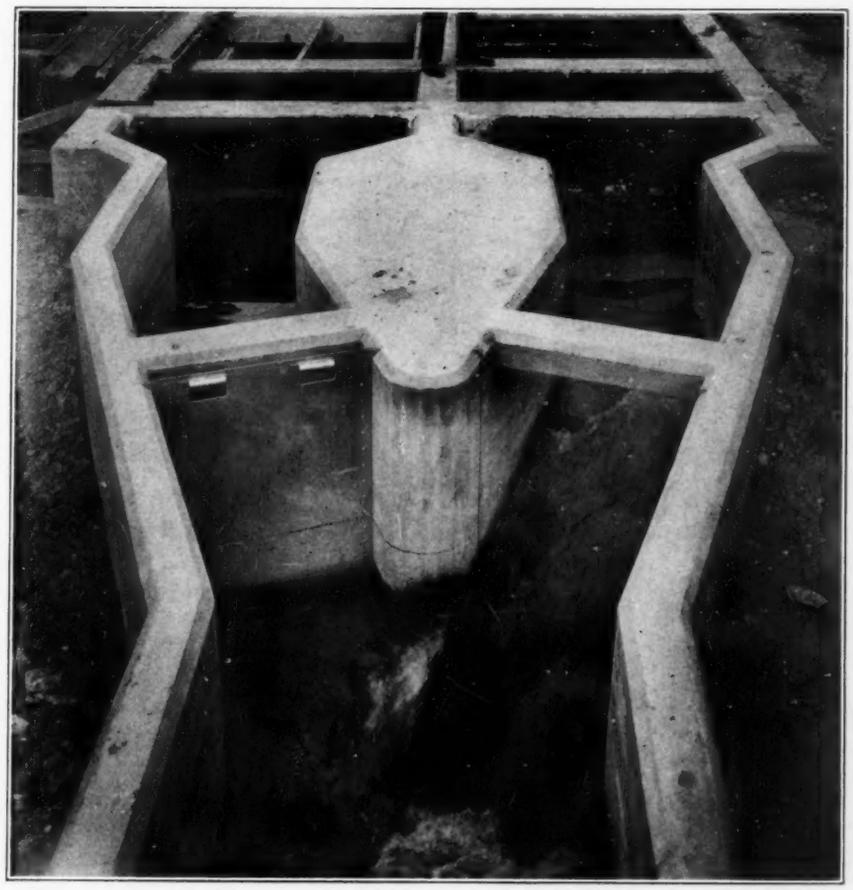


Fig. 5—Completed Grit-Chamber Control Section in Service at the Lakewood Plant.

TABLE A—COMPUTED ELEVATION FOR WATER SURFACE IN GRIT CHAMBERS, AND ELEVATIONS DETERMINED FROM MODEL STUDY

Rate of Flow				$\frac{v^2}{2g}$	$\frac{1.1\,v^2}{2g}$	Water Surface Elevation	
m.g.d.	c.f.s.	d_c	v			Computed	Observed in the Model
2.0	3.09	.321	3.21	.160	.176	19.50	19.51
4.0	6.19	.509	4.05	.255	.281	19.79	19.81
6.0	9.25	.666	4.64	.335	.369	20.04	20.06
8.0	12.38	.810	5.10	.404	.444	20.25	20.26
10.0	15.47	.939	5.50	.470	.517	20.45	20.46
12.0	18.57	1.06	5.84	.530	.583	20.64	20.64
14.0	21.66	1.17	6.17	.592	.651	20.82	20.82
16.0	24.76	1.28	6.45	.647	.712	20.99	20.99
18.0	27.85	1.39	6.67	.692	.757	21.15	21.15

Purpose of Model Tests

The purpose of the model tests was to verify the calculations, and to furnish the manufacturer of the flowmeter equipment with the correct rating curve for the structure. Calibration of the structure by means of a hydraulic model study is preferred to calibration of the actual structure under service conditions. The model study is quicker, more accurate, and less costly. Measurements on the model can be converted to equivalent measurements on the prototype, if the laws of dynamic similarity are observed throughout the work. In a model study of this character, gravity forces are dominant as against forces inherent in the properties of the water, such as viscosity, compressibility, and surface tension, whose influence may be considered secondary or negligible. For that reason it is sufficient for virtual similarity in these tests, that Froude's number be the same in model and prototype at any stated flow, or in other words, that $V_m = V_p \sqrt{Z}$ where "z" is the linear scale reduction factor (in this case 1/6), and, as a corollary, that $Q_m = Q_p\,(Z)\,^5/_2$. Friction effects are negligible through this short transition section, in either model or prototype. The losses considered are dynamic losses.

Novel Specification

Specifications for the flowmeter equipment at the Lakewood plant contain the following novel clause:

". . . The flow meter shall be provided with flow scale sheets and totalizing gearing to conform with the actual discharge rating of the grit chamber and transition of outlet channel as shown on the drawings. The rating shall be determined by a hydraulic model test to be made by the Civil Engineering Department of the Case School of Applied Science in a manner satisfactory to the Engineer. The cost of the hydraulic model study shall be included in the price bid for the equipment in the proposal."

Description of the Model

The general construction of the model is pictured in the accompanying photograph. The model is of watertight construction, made of tongue and grooved lumber, pretreated to resist warping, and painted with aluminum paint. Its inside dimensions correspond to those of the structure as built, and are proportionally accurate. The model is set level in a steel flume. Inflows are controlled by feeding the supply pipe under constant head at the predetermined rate, which is measured by a 4-inch Venturi meter, whose rating is periodically checked by volumetric gaging of the discharge in calibrated steel tanks. At the outlet end of the model the tailwater can be arbitrarily set to any elevation desired. Lebel rails located on either side of the model support a bridge carrying a rider to which a point-gage is attached, for measuring the water surface elevation to .001 ft. in the model. A piezometer opening in the grit chamber sidewall, connects with a stilling well in which this water surface elevation can be independently checked by means of a hook-gauge mounted on a fixed stanchion. All gages and elevations are referred to a laboratory benchmark.

Method of Conducting a Test Run

In establishing a rating curve for a fixed set of conditions, constant flow at some arbitrary valve opening is admitted to the model, and the hydraulic gradient allowed to stabilize. The rate of flow is then carefully read by U-tube manometers of high sensitivity, connected with the Venturi meter, and the water surface in the grit chamber is determined by the two independent gages. For the next reading, a higher rate of flow is

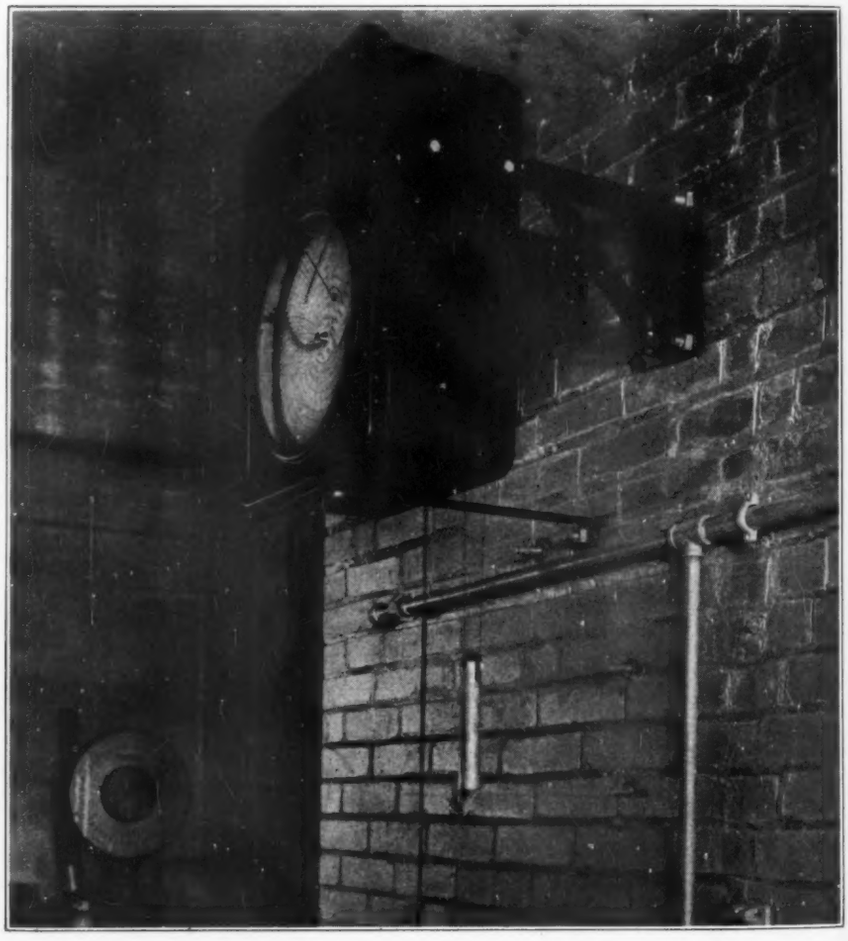


Fig. 6—Flow Indicating, Totallizing, and Recording Instrument Furnished by The Bailey Meter Co., Operating from a Float Well Connected with the Grit Chambers.

set, and the procedure repeated until sufficient points are determined on the rating curve. No measurement is allowed which cannot be repeated at will. Critical elevations on the model, and all gages are checked against the benchmark at the beginning and end of each run.

Data Recovered in Tests

In Table B, the results of the test runs are given:

TABLE B—DATA ON TESTS

Rate of Flow Qp=Qm×88.2 MGD	Venturi Water Reading Manometer ft. CCl_4	Gage Readings Hook Gage Feet	Gage Readings Point Gage Feet	Indicated W.S. Elevation in Nature
TEST NO. 4		Specific Gravity of CCl_4	=	1.592
S. A. Carlson		Coefficient of 4 x 2 meter	=	0.97
H. L. Weiss		Zero of Hook Gage		19.00
		Zero of Point Gage, Elev.		19.00
1.82	.056	.081	.080	19.485
3.50	.207	.125	.124	19.747
4.06	.278	.137	.135	19.817
5.22	.459	.161	.160	19.962
6.24	.657	.180	.179	20.076
6.72	.762	.188	.188	20.127
7.92	1.071	.210	.210	20.261
8.63	1.258	.222	.221	20.330
9.77	1.612	.240	.242	20.449
10.06	1.710	.244	.246	20.471
10.90	2.008	.257	.256	20.537
12.04	2.440	.272	.274	20.642
12.38	2.585	.279	.277	20.667
13.91	3.269	.302	.302	20.812
14.20	3.400	.305	.307	20.840
15.90	4.275	.330	.330	20.979
16.25	4.460	.334	.336	21.012
17.89	5.390	.354	.357	21.135
18.24	5.613	.360	.363	21.161

Note: The W.S. elevation shown in this test was computed from the weighted average of two hook gage readings and four point gage readings.

Discussion of Tests

The final design for the grit chambers was with floor at Elev. 17.21, plus a minor change in the floor transition between elevations 17.21 and 19.00. The changes were made in the model for final tests. The grit collector flights were reproduced in the model to scale, and their position shifted to successive locations to see if they would influence the rating curve. The only point at which the rating curve seemed to be at all affected, was when a flight in its travel was stopped at a point directly over the downstream pair of sprockets. In this position, with flows exceeding 12 MGD, the water surface in the grit chamber was raised slightly, introducing an error of about 0.25 MGD in the indicated flow. The error would not appear if the flight were passing this point in its travel, but only if the flight were to be held some time in that fixed position. Such a circumstance would be accidental, though possible. However, since the greatest error would in any case be but about 2.0 percent in the discharge, it was concluded that the flights were not a factor in establishing the rating curve. The computed and observed rating curves may be compared by reference to Fig. 3—"Outlet Control Section Rating Curve". The average observed value of the constant "k", assumed as 0.10 in the preliminary calculations, proved to be 0.1298 on test. The actual water surface elevation, therefore, averages slightly higher than computed, but the error in the indicated discharge is about 1.5% only, and not over 2.0% at any point, which is considered unimportant. Nevertheless, the observed curve, and not the computed curve, was used in designing the meter.

Effect of Submergence

In the Lakewood plant, flow through the control section will always be at the critical depth, and will not be submerged by tailwater in the Imhoff tank header channel downstream. As a matter of interest, however, it was possible to demonstrate by the model that the rating curve for the control section would not be affected by high tailwater. that is to say, tailwater appreciably above the hydraulic gradient in the control section.

Precision of Concrete Work in Construction

It was tacitly assumed that the concrete work for the grit chamber control section would be built at Lakewood with a precision warranting the close work done on the model. To check this, levels were taken on the floor of the control section as built. It appears that the concrete floor does not vary from the established elevation of 19.00 by more than 0.02 ft. at any point, which is negligible. The newly built structure is shown in Fig. 5, operating at 6.0 MGD, or about normal flow. The float operated meter, which was furnished by the Bailey Meter Company of Cleveland, Ohio, is shown in Fig. 6.

Various devices for control of velocities or for measuring discharge, or both, have been employed in grit chamber design. However, it would appear that the type of design described herein may be used to advantage in many cases. It has all the desirable features inherent in a properly proportioned control section. The proportions can be derived in any given case by very simple methods of analysis based on fundamental hydraulic principles. It lends itself to the use of accepted types of grit removal equipment. It is economical and easy to construct.

Acknowledgments

The writer wishes to express his appreciation for the privilege of serving as Consulting Engineer on these problems to Rollin F. MacDowell, Civil and Sanitary Engineer of Cleveland, Ohio, who designed the new Lakewood Sewage Plant, and also to acknowledge cooperation on the model studies from Mr. B. P. Sherman of the Bailey Meter Company, Mr. E. A. Fisher, City Engineer of Lakewood, and Messrs. R. B. duPont, W. H. McClarran, C. A. Carlson, and H. L. Weiss assistants in the laboratory.

COMPENSATION RATES FOR WATER WORKS EMPLOYEES REDUCED

The "News Letter" of August, 1939, a monthly publication of the Pennsylvania Water Works Association, reports the reduction of Workmen's Compensation Rates for water works employees for Pennsylvania. The revision of rates by the recent legislature brings about a material savings to water companies in Pennsylvania. Effective July 1st, 1939, with a refund credit allowed on payments made during first half of 1939.

Annual Rates per $100 Payroll

	Old	New
Office Force	$0.13	$0.07
All Others	$2.05	$1.50

Percent Reductions

Office Workers	=	46.2%
Other Employees	=	28.3%

THE SEWAGE TREATMENT PLANT OF OLEAN, N. Y.

By JOSEPH E. REHLER, Supt.
Water and Sewage Works
OLEAN, NEW YORK
and
NEWELL L. NUSSBAUMER
Nussbaumer and Clark, Engrs.
BUFFALO, NEW YORK

THE City of Olean, N. Y., is located in Cattaraugus County on the Alleghany River in the southwestern part of New York. It has a population of about 24,000 persons. There are no industries in the city which produce large amounts of industrial wastes which would become a problem in treatment. However, the presence of many oil wells in the vicinity and the seepage from oil storage tanks have saturated the ground over a period of years in certain sections so, when there is a high ground water level, infiltration into the sanitary sewers includes oil and gasoline which appears at the treatment plant.

About eighty percent of the area of the city is provided with separate storm sewers which empty into the Alleghany River. Storm sewage in the other twenty percent enters the sanitary sewers. In addition the roofs of houses are generally connected with the sanitary sewers. Consequently when there is a rain the flow increases to as high as fifteen times the dry weather flow. It is the intention of the city to remove all surface drainage from the sanitary sewers as funds permit.

The sanitary sewage is delivered to the head of the general outfall sewer, where the sewage treatment plant is now located, through two trunk sewers, 30″ and 42″ trunk sewers. About 25 percent flows by gravity. The balance is pumped by three booster pumping stations serving various sections of the city. One, the Fourth Street Station, acts as a storm water relief station. It has a pumping capacity of about 10 M.G.D. and at high storm flows, and pumps most of the flow directly to the Alleghany River. Prior to 1939 the domestic sewage was discharged without treatment into the river.

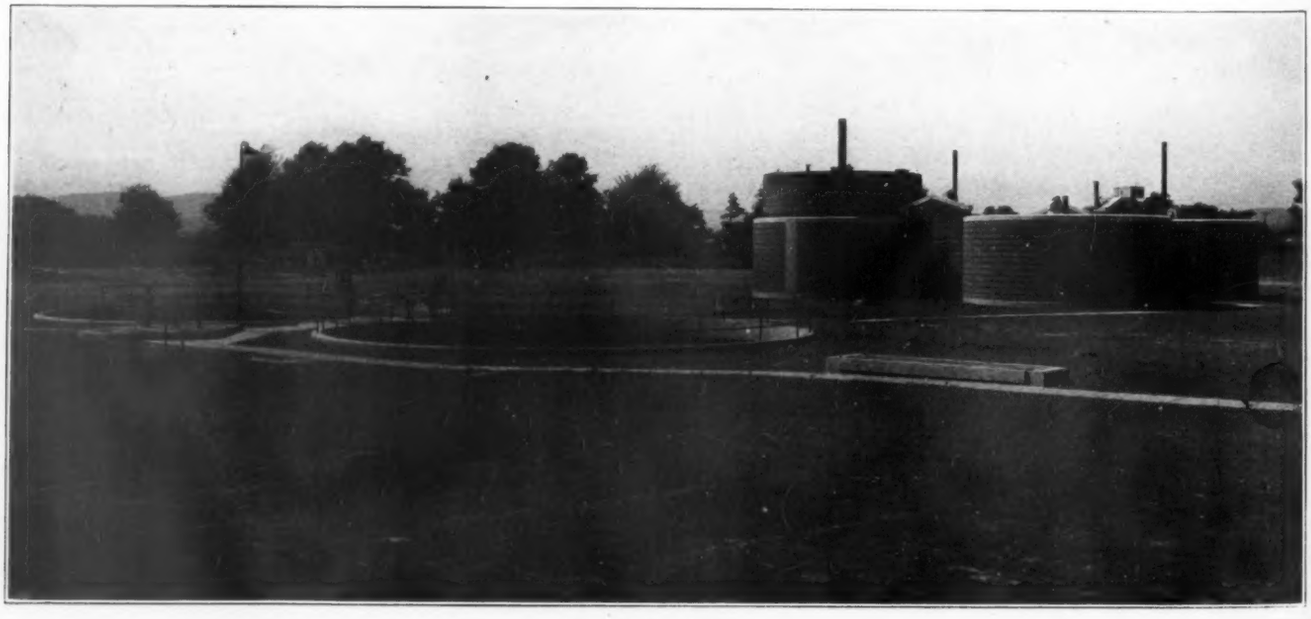
At the head of the outfall sewer there is a storm water relief pumping station built about 1926 with two electric driven pumps and one gasoline engine driven pump which when the river is high pumps the sewage against the high water level which rises several feet above the sewer level. At normal river stage the sewage flow can discharge by gravity.

The water consumption over a period of the last few years has varied from 2 to 2.5 M.G.D. The measured flow to the general sewer outlets, before constructing the treatment plant, between varied rates of 1 to 10 M.G.D. for dry weather conditions. This variation is partly due to the booster pumping station schedules, and also to infiltration.

Olean Decides to Build a Treatment Plant

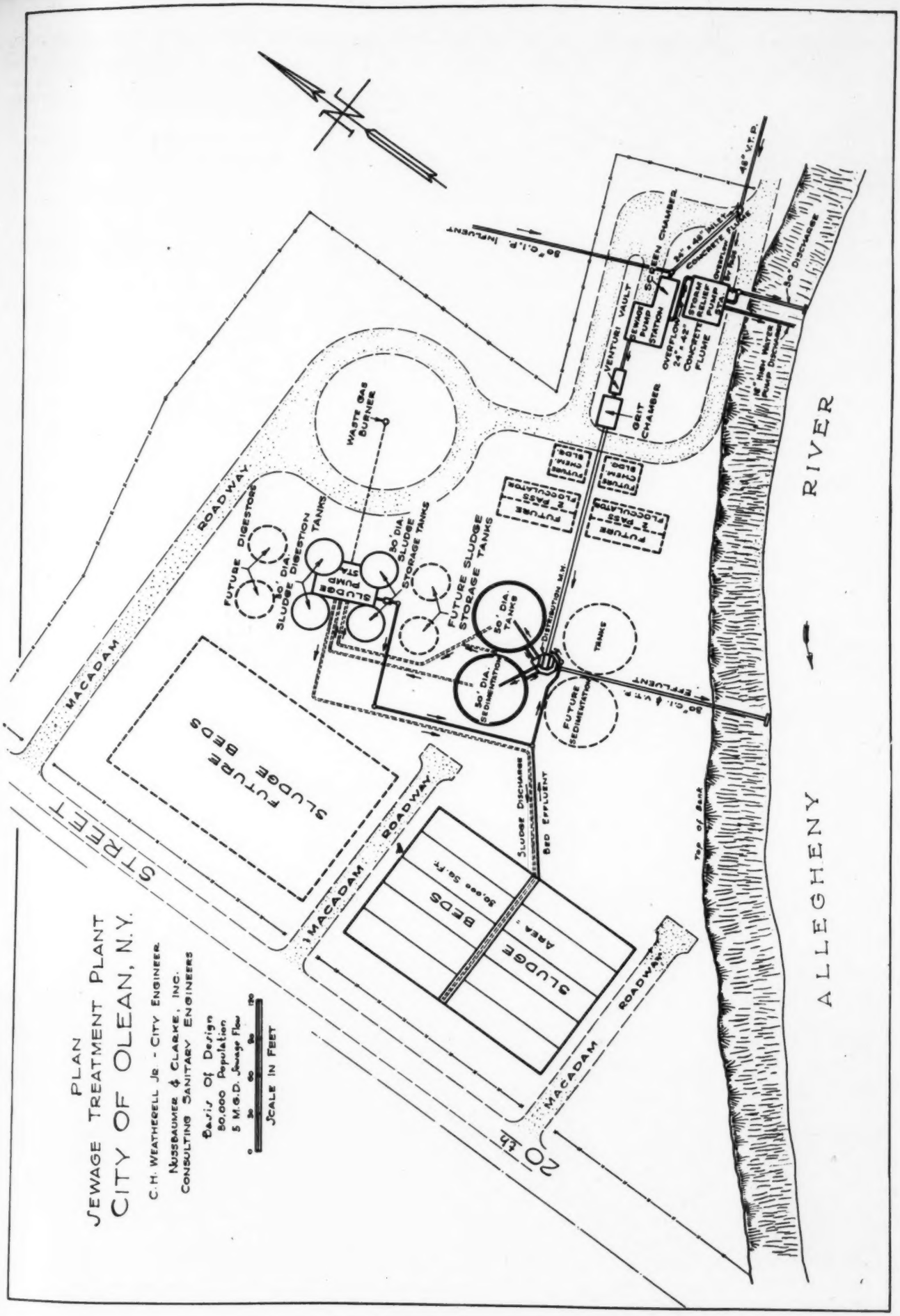
In the fall of 1936 the New York State Department of Health held a hearing at which the City of Olean was asked to show cause why it should not discontinue emptying untreated sewage into the waters of the state. As a result of this hearing city officials proceeded to have plans prepared for a sewage treatment plant, and the plant has been built as a W.P.A. project. The work was started in the spring of 1937 and was completed insofar as the structures were concerned, and placed in operation in January, 1939. The landscaping and driveways and ground improvements have been built this summer.

The treatment plant is located at the head of the outfall sewer to the river and adjacent to the storm water relief station. The site although adjacent to the river is protected from high water by a dyke system. The city acquired sufficient land to accommodate all the present structures required, with room for expansion to approximately twice the present ca-



The Olean Plant

Twin Dorr Clarifiers and Sludge Digesters, Gas Holder and Storage Tank. Sludge Beds on the Left.



The Sewage Treatment Plant of Olean, N. Y.
Plan Showing Arrangement of Units

The Olean Plant Grit Chambers (left) and Pumping Station

pacity, and inclusion of secondary treatment if this should be required or desirable for proper sanitary conditions in the Alleghany River.

The basis of design was 30,000 population, which allows for about 20 percent increase over the present population and a sewage flow of 5 M.G.D., the latter appearing to be the most frequent rate of flow during the day. This flow figure is, of course, high on a per capita basis, but conditions prevailing at the plant the first eight months of operation indicate that it is not excessive. The volume of flow in the Alleghany River indicated that primary treatment would produce acceptable results for the present. Therefore, a plant providing primary treatment only was designed. However, sufficient studies and plans for secondary treatment were prepared, so that if and when supplementary treatment might be required, additional structures to accomplish this result could be added with a minimum amount of alterations to the existing structures.

The Plant

The sewage treatment plant includes the following treating structures, which are laid out on the site with good space allotments as shown on the plot plan of the site.

(1) Pumping Station (housing sewage pumps, screening facilities, chlorination equipment, laboratory, office and locker room); (2) Venturi Vault; (3) Grit Chamber; (4) Distribution and Collection Chamber; (5) Sedimentation Tanks; (6) Outfall Sewer and Control Gate; (7) Sludge Pumping Station (housing gas collection and heating equipment); (8) Sludge Digesters and Storage Tanks with Gas Holder; (9) Sludge Beds.

In designing the individual structures in addition to sanitary and technical considerations, there was always kept in mind the fact that, since the plant was to be built as a W.P.A. project, the type of structures insofar as possible, without sacrificing efficiency, should produce a maximum of labor and a minimum of material and equipment requirements in construction.

Screening Facilities

Two intercepting chambers were built to divert the flow to the new pumping station. One is provided with a storm water bypass, which connects with the existing storm water pumping station. The sewage flow enters the new pumping station at an elevation about 17 ft. below grade. Two screen channels are provided ahead of the pumps. One is provided with a mechanically raked bar screen and screenings grinding "Triturator" unit, manufactured by the Chain Belt Co. The screen operation is automatically governed by a differential head type control, manufactured by The Dorr Co. In the second channel a hand raked screen is provided. The rate of flow through the screen channel is regulated by adjustable proportional weirs..

Pumping Facilities

The sewage pumping facilities include three pumping units, one of 4 M.G.D. and two of 6 M.G.D. capacity, each against a head varying from 20 to 25 ft. The pumps are of the vertical centrifugal type, operating at speeds of about 400 R.P.M., driven by Louis Allis geared motors mounted on the ground floor of the building. The shafting is of the Watson Spicer type, which makes a neat and economical installation. The entire pumping installation was provided by the American Well Works Co.

The pump operation is controlled by a multiple type float switch which places the 4 M.G.D. pump in operation first. Upon increasing level in the wet well the 6 M.G.D. pump is placed in operation and the 4 M.G.D. drops out. Upon further increase in liquid level the 6 M.G.D. unit continues to operate and the 4 M.G.D. unit is again placed in operation. A selector switch is provided on the panel board so that either of the 6 M.G.D. pumps can be placed in operation, but if all three pumps are to operate the third must be operated manually. To further protect the station when flows exceed the capacity of two pumping units, a total of 10 M.G.D., a bypass from the wet well to the storm pumping stations begins to operate. The control panel, manufactured by Cutler-Hammer of Milwaukee, was supplied through McCarthy Bros. & Ford of Buffalo.

Sewage Meter

A venturi throat having a capacity up to 20 M.G.D., and installed in the discharge from the pumps, is connected with an indicating and recording meter, mounted in the control room and supplied by the Simplex Valve & Meter Co. of Philadelphia.

The monthly flows and amount of screenings removed from the bar screens are shown in the following table. It is interesting to note that the production of screenings is directly proportional to the flow. These screenings however are not removed but are macerated by the "Triturator" unit and returned to the sewage.

Pre-Chlorination Provided

The chlorination equipment is also located in the pump station. Prechlorination in the pump wet well is provided. Provision can be made, if desired, to post-chlorinate at the distribution chamber from these same machines.

Two 450 lb. capacity Master Vacuum Type Chlorinators as manufactured by the Wallace & Tierman Co. are provided. One is an automatic machine, the converter being connected with the venturi throat. Under normal operation this machine is used. The other is placed in operation manually and is used in case of high flows or as a standby for the automatic machine. Chlorine is

RECORD FLOWS AND QUANTITIES OF SCREENINGS

Month	Total Flow Gals. Mo.	Av. Flow M.G.D.	Total Screenings Cu. Ft. Mo.	Av. Screenings Cu. Ft. Day
March	133,873,000	4.3	206	6.6
April	100,185,000	3.3	142	4.7
May	66,906,000	2.2	55	1.8
June	46,888,000	1.6	59	2.0
July	65,820,000	2.1	59	1.9

provided in ton containers, dosage being checked by scales provided by the Buffalo Scale Co. A craneway and hoist is provided for handling the containers.

Chlorination is heaviest during the summer months when the flow in the Alleghany River is lowest, and when it is necessary to protect bathers using river waters downstream. A residual of 0.5 p.p.m. is generally secured in samples taken from the distribution chamber *after* sedimentation. The dosage of chlorine has been at the rate of 45 to 85 lbs. per M.G. to produce this residual, as indicated in the following table. During dry weather months the rate per million gallons is, of course, higher.

When high storm water flows occur at the station in excess of the pumping capacity during low flow, it is the intention to use the second chlorinator to disinfect the excess flow bypassed.

Laboratory

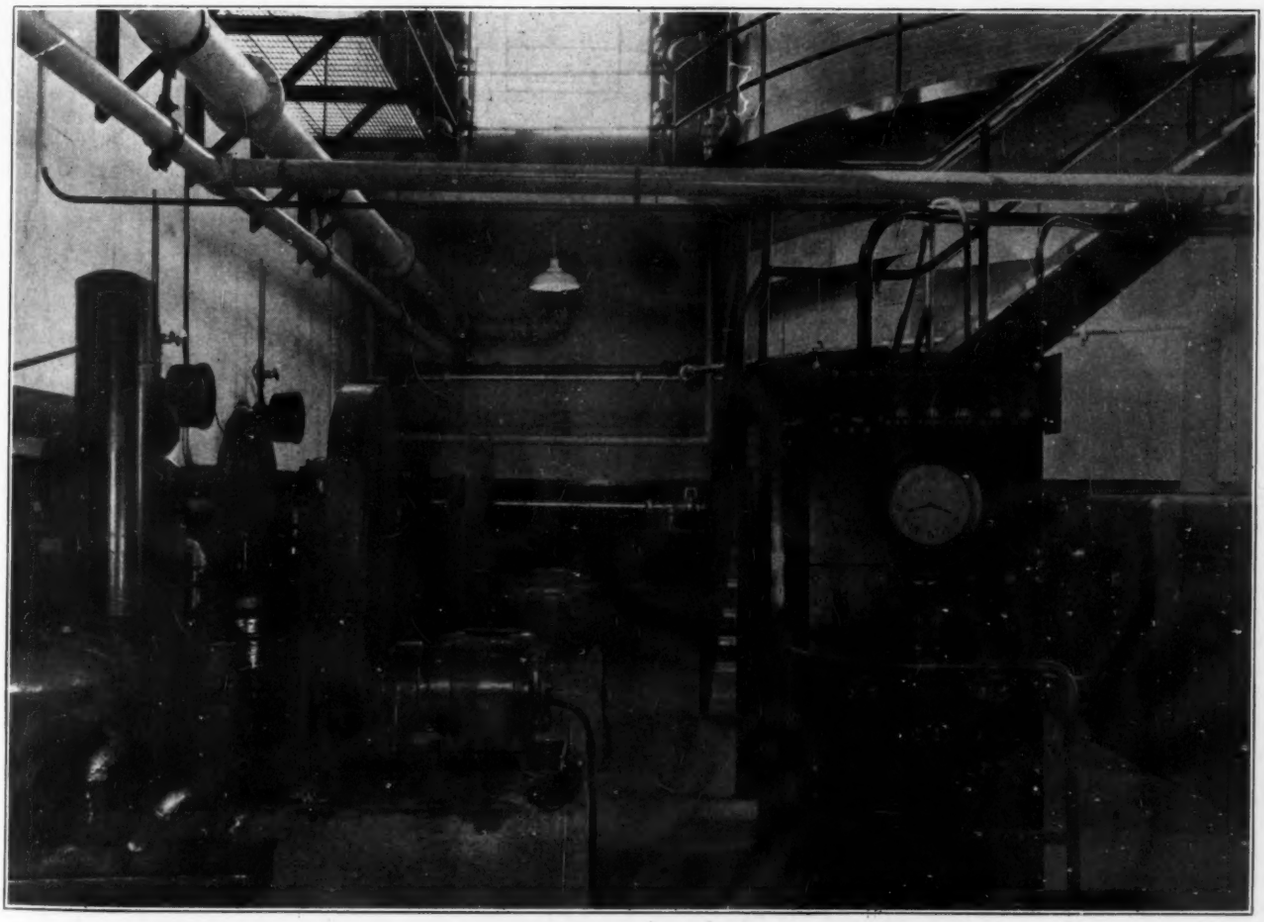
A laboratory is provided with adequate facilities for testing and controlling all phases of plant operation. Adjacent to the laboratory is an office where records are kept. In designing the upper floor, consideration was given to the convenience of the operator. The control panel and flow meter in the control room can be seen from the office and laboratory through glass partitions, and the chlorinators can also be observed from either. A locker room with a shower is provided. The heating boiler and hot water heater are designed for burning sludge gas. Temporary heat was provided from the city gas main this spring but this fall sludge gas which is now available will be used.

Grit Chamber

Because of the depth of the entering sewers, it was decided to con-

Month	Chlorine Pounds	Flow M.G.	Lbs. Per M.G.	P.P.M.*
March	6170	133.8	46	5.52
April	4800	100.2	48	5.76
May	4124	66.9	62	7.44
June	3934	46.9	84	10.08
July	4280	65.8	65	7.80

*Note the increase in chlorine demand with the advent of warm weather. Note also the low requirement for crude sewage chlorination in the spring months.



Interior of Digester and Sludge Control House

(Sludge pumps and meters on left; control panel and gas fired boilers on right. Note arrangement of piping on digester walls above and plug-type valves.)

struct the grit chamber on the discharge side of the pumps and above ground. A hopper type was selected to conserve ground space and to fit in with the topography, the original ground being 8 ft. below finished grade. This device has operated quite satisfactorily, and has settled out considerable quantities of grit.

During the five month period to date there has been collected in the grit chamber and removed to a filling ground 1500 cu. ft. of material. This averages 10 cu. ft. per day but, of course, is heaviest in the spring when melting snows bring cinders from the pavements to the plant. In addition a city wide sewer cleaning project dislodged accumulations of material which all was flushed down to the plant.

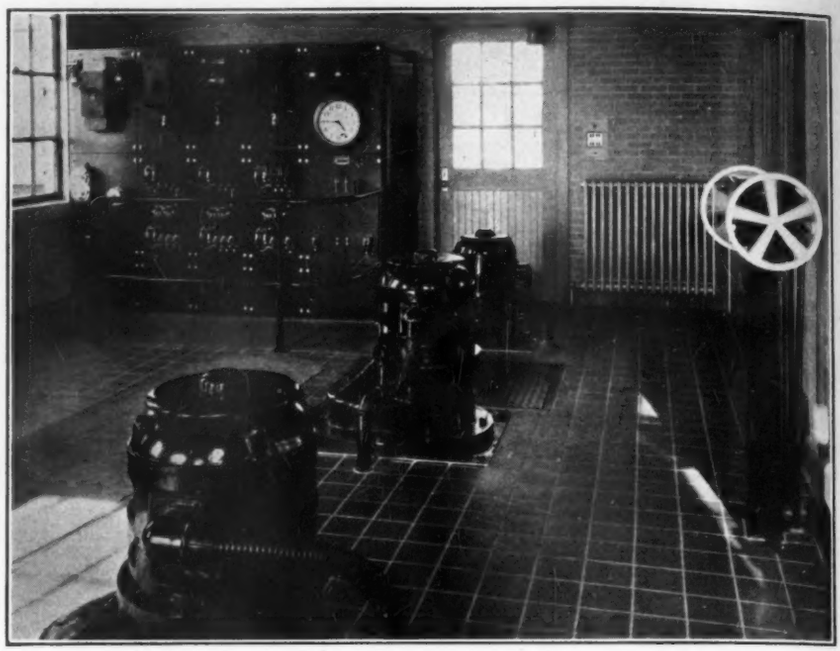
Chemical Treatment Planned When Needed

The effluent from the grit chamber flows by gravity to the distribution chamber through a 24 in. pipe or flume. Between the distribution chamber and the grit chamber space is provided for secondary treatment structures if and when required. The preliminary design includes flocculation basins and a chemical building in which feeders of the required type can be installed, together with adequate chemical storage.

The distribution chamber consists of two series of channels controlled by stop gates. The inner series distribute the flow to the sedimentation tanks and the outer channel collects the flow from the sedimentation tanks. Provision is made for connecting two future tanks. The outfall from the distribution chamber is protected from river backflow at high stages by a sluice gate. All of the stop gates are built up of sheet aluminum with angle braces.

Settling Tanks

The two sedimentation tanks are 50 ft. in diameter with a sidewater depth of 10′ 9″ and provide a detention period of 2 hrs. at design flow. They are of the center feed type, with radial flow to the circumferential overflow weir. The sludge and scum removal mechanism is supplied by The Dorr Co. The schedule of operation calls for running the mechanism for one hour and off for one hour. Sludge is pumped from the tanks at 8 A.M.—11:30 A.M.—3 P.M.—and 10 P.M. With this arrangement no septic sludge has been noticed, and the sludge is of such consistency as not to clog the suction pipes.



Sewage Pump Motors and Automatic Control Panel
(On right is float switch for automatic pump control.)

Digesters

The sludge treating facilities consist of two digesters equipped with Downes 'P.F.T.' floating covers, and two sludge storage tanks, one equipped with a floating cover and the other with an 8,000 cu. ft. gas holder. The tanks are all 30 ft. in diameter, 25 ft. side depth with an 8 ft. cone, and provide about 36,000 cu. ft. of sludge digestion capacity and a similar amount of storage. The two digesters are equipped with heating coils and are maintained at a temperature of 90°F. by circulating hot water through the coils. They also have three scum jets located just under the cover. These have been particularly helpful during the initial stages of operation in reducing the scum depth, and keeping foaming to a minimum.

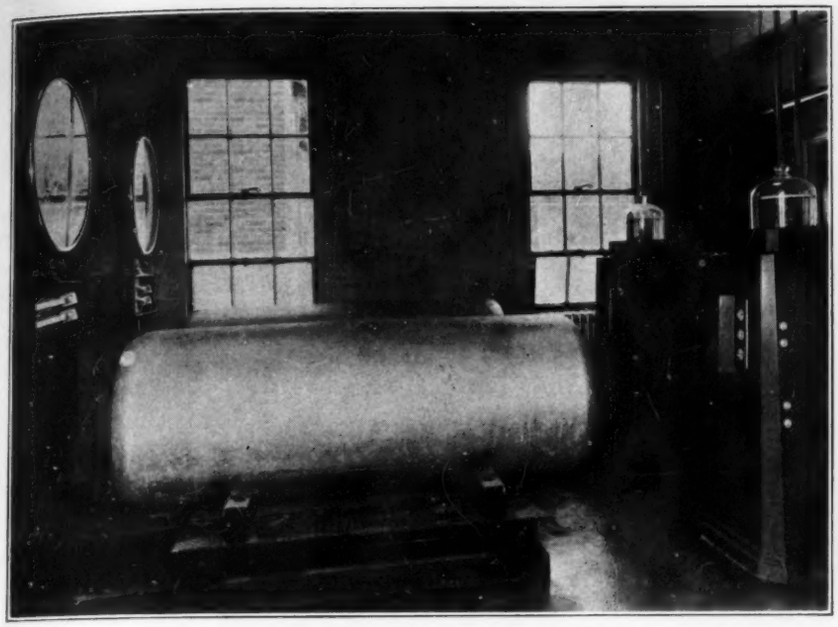
Foaming has been confined to the tanks with no overflow. Gas collection piping conducts all gas produced to the gas holder. The piping is provided with pressure relief valves so that excess gas beyond the capacity of the gas holder flows to the waste gas burner where it is burned. The floating covers, flame traps, pressure reducing valves and gas holder were all supplied by the Pacific Flush Tank Co. As gas in any appreciable volume was not produced until summer, and as only the hot water heating boiler is in use, the greater proportion of gas has been wasted. This, however, will not be the case when cold weather comes as heating boilers in all buildings will use sludge gas.

The sewage pumping station was placed in operation on Jan. 6, 1939. The digesters were started about Feb. 16th and the first indication of gas was noticed about May 15th. Gas prior to June 6th was unburnable and unmetered. Since then gas produced has reached a maximum of 29,700 cu. ft. in 24 hours and now (August) is averaging about 17,000 cu. ft., with indications that production will stabilize at about 15,000 to 16,000 cu. ft. per day, which will be something over 0.6 cu. ft. per capita.

Digester Experiences

The digesters were started one at a time. The first digester was started with unseeded sludge and with no addition of lime. The pH dropped rapidly to 5.4 about March 15 and eventually reached 4.8. At this point lime was added starting April 4th in small daily doses of from 100 to 200 lbs. so that in the latter part of June the pH was up to 7.0, and the addition of lime was discontinued. Since then the pH has been about 7.2. Early in June evidences of foaming were noted even though the pH was up, apparently caused by a heavy layer of top sludge. This top sludge was withdrawn to the beds late in July, and since then no further trouble has been noticed.

The second digester was started with seeded sludge, and the pH was kept above 6.6. However, the same indication of foaming was noticed with this tank. Top sludge was withdrawn and since then no further trouble has been experienced.



W. & T. Chlorinators and Buffalo Scales
(Provide pre-chlorination at Olean.)

This heavy accumulation of top sludge contained hair, and may have been tannery wastes, from industries which were operating up to 1932 in Olean, and which material was driven down to the treatment plant during the sewer cleaning—and flushing program.

Sludge Handling Facilities

The sludge pumps installed are the double plunger type, manufactured by the Ralph B. Carter Co. The piping arrangement is quite flexible so that any desired combination of pumping can be secured. Sludge meters, as manufactured by the Bailey Meter Co., are provided on the discharge lines. Thermometers and sludge depth gauges are set in the digester walls. This equipment was supplied by the Foxboro Company. Forced ventilation for the control house is provided so that an air change in 7 to 9 minutes can be had if desired. All of this equipment is housed in the control building occupying the space between the four tanks. No pipe tunnel is required. The exterior of the tanks and building is finished with a red paving brick made in Olean by the Sterling Brick Co. It is inexpensive and for this class of work presents a very pleasing appearance.

The sludge beds are of the open type and have an area of 30,000 sq. ft. The underdrainage is provided by Metro-tile Filter Blocks set at the low drainage point of each bed. Concrete runways are provided on the top of the beds so that small trucks can run in and remove the dried sludge without unnecessary rehandling. Only top sludge has been withdrawn to date, however, even this sludge dried well and without noticeable odor. The filter effluent from the beds is returned to the distribution chamber.

Plug Type Valves Used Throughout

The Merco Nordstrom lubricated plug-type valve has been used throughout the plant on all sludge and scum lines.

The general ground improvements including grading, driveways, seeding and landscaping have been under the supervision of Mr. Chester Weatherell, Jr., City Engineer, who has cooperated on many phases of the work since its inception.

Water and Sewage Now Under One Head

Upon completion of the project the Water Department was placed in charge of the Sewage Treatment Plant and, effective June 1, 1939, the jurisdiction of the department was enlarged to include the water filtration plant and pipe lines, the sewage treatment plant, all sanitary and storm water lifting stations, and gates and other appurtenances pertaining to the system of dykes protecting the city from flooding by the Allegheny River. In this way all operating procedure relating to sanitation, water supply and flood control with the exception of the sewerage collection system is combined under one administrative head.

The construction as previously stated was done by the W.P.A. The city's share of the cost for skilled labor, materials, equipment and professional services was $132,000, not including the plant site. The superintendent for the W.P.A. was Mr. Robert Seitler, and resident engineer for the Consulting Engineers, Mr. David Brown. The combination of competent supervision and close cooperation between the city officials and the W.P.A. produced a very satisfactory job.

1,000,000 Pounds of Solids Removed

In conclusion, since the purpose of the treatment plant is to purify the river into which the sewage effluent is discharged, it is well to point out the degree of sewage solids removal, and resulting improvement in river conditions. The Imhoff cone tests indicate an effluent free from settleable solids at all times. Neighboring downstream communities report river conditions much improved over previous years. During the six months the plant has been in operation it is estimated that 1,000,000 lbs. of solids, which otherwise would have been discharged into the Allegheny, have been retained in the plant.

BUFFALO'S $4,500,000 SEWAGE PLANT TO BE DEDICATED

On September 12th, Buffalo, N. Y., will formally dedicate its new Sewage Treatment Plant which cost the city $4,500,000 to build. This plant, however, went into operation June 29th, 1938.

The occasion will have public significance somewhat beyond signallizing modernization of the disposal of sewage by a large city, in that the Buffalo plant restores the purity of the Niagara River and, thereby, definitely ends an international controversy. Pollution of this famed boundary stream between the Dominion of Canada and the U.S.A. became only a memory when the new plant of Buffalo went into operation. It was an important step in cleaning up the "3,000 mile frontier without a fort."

Amongst the scheduled speakers will be found many important men, including Buffalo's Senator, Congressman, the Mayor, the State's Commissioner of Health, the State Comptroller, the Chairman of the Sewer Authority, and high officials in the P.W.A.

The Editor's Comments

ABOUT six years ago water works men were aroused to the hazards and the possible dire consequences which electrical grounding of house circuits to service pipes could be and apparently had been responsible for. By exhibits and accounts presented before it, so impressed was the membership of the American Water Works Association with the hazards of grounding to water pipes that in 1935 the Association passed a resolution disapproving and condemning the practice. However, the effort to do away with grounding to water piping has since proved impracticable of attainment on very practical grounds—namely, necessity of the practice as a safety measure protecting the users of electrical equipment.

In view of the existing resolution, and to caution water works managers of possible jeopardy of attempting to have grounding to service pipes discontinued, on January of this year the Committee on Electrical Grounding presented to A.W.W.A.'s Board of Directors a report and recommendation that the following statement be made to the membership through the Secretary's office. The statement of warning, mailed out promptly, had the following to say:

> "You are advised that although the practice of grounding electric service lines on domestic water service pipe is in effect in most cities, the water department does not place the connections, derives no benefit from them, may be damaged by them, and tolerates them only because of their reputed importance in providing electric service. While the water supply industry as a whole does not accept responsibility for the providing of means of disposal of stray or waste electric current, water department executives are advised **not** to order the removal of electrical grounds of alternating current systems from water pipes unless they have been informed by competent legal counsel that such removal order can be supported in the case of court action."

There appears to be more than one reason for sending out such a "stop, look and listen" warning by A.W.W.A. The first is that to-date sufficient proof is not available that grounding to water pipes has caused the extent of damage to water quality or water supply piping, meters, etc., which was pictured for it when the practice was condemned by A.W.W.A. in 1935. Second, that prohibiting of house system grounding, if responsible for injury to persons as the result of electrical shock, will in all likelihood throw responsibility for such damages squarely on the shoulders of the water utility or water department.

In respect to reason No. 1, the recent report of the Research Committee on Electrical Grounding, presented before A.W.W.A. in June, certainly fails to startle anyone in respect to available evidence of damages to water works equipment or personnel that can not be overcome through reasonable precautions and betterments to existing grounding practices. Since 1936 the joint American Research Committee on Grounding (composed of members of A.W.W.A. and representatives of the Edison Institute) have been studying the grounding problem; but, like a similar British committee in The Institution of Civil Engineers, finds it difficult to draw any definite conclusions from the work to date. The report by the chairman for A.W.W.A., Chas. F. Meyerherm, states—

> "The question whether alternating current on water pipes does or does not have a detrimental effect on pipes, or the water within them, is still undecided; and, while the committee has no positive proof that such harmful effects do occur, this lack of evidence does not prove that the action can not take place."

The studies already made and being extended will unquestionably lead to several worthwhile constructive suggestions in connection with grounding methods as well as piping practices, and this in itself will constitute a worthy contribution. We have an idea that such suggestions, leading to improved practice, may remove what concern now exists in respect to deleterious effects of grounding. For instance, the committee has already spotted the grounding-clamp, and the practice of application, as a weakness from the electrical viewpoint as well as that of the water utility.

During its existence the Committee on Grounding has continuously sought complaints to investigate. In three years only 40 cases of troubles, thought to be due to grounding, have been reported for investigation. Twenty-three of these were pipe corrosion cases; five were tastes and odors, four were sediment complaints. In almost every instance, where any worthwhile proof could be had, the evidence pointed to water quality as the responsible cause, and *not* electrolysis. The report points out that the uncertainty concerning the major phase of the committee work to date, arises from the insufficiency of cases and troubles reported.

It must strike those who heard (or may read) the report, that the paucity of cases reported to the committee for investigation is indicative of a general lack of belief that grounding is the source of troubles once considered so important as to justify A.W.W.A. to take steps to have the practice abolished.

The joint Research Committee, now "tooled" with equipment and methods to do a real job in laboratory and field investigation, makes a strong plea for case reports and urges cooperation of water works laboratories in a position to assist in conducting or supervising tests and collecting data on the job. In this, the committee's laboratory-developed measuring sticks can be applied in the field, where practical operating conditions exist and can best be evaluated.

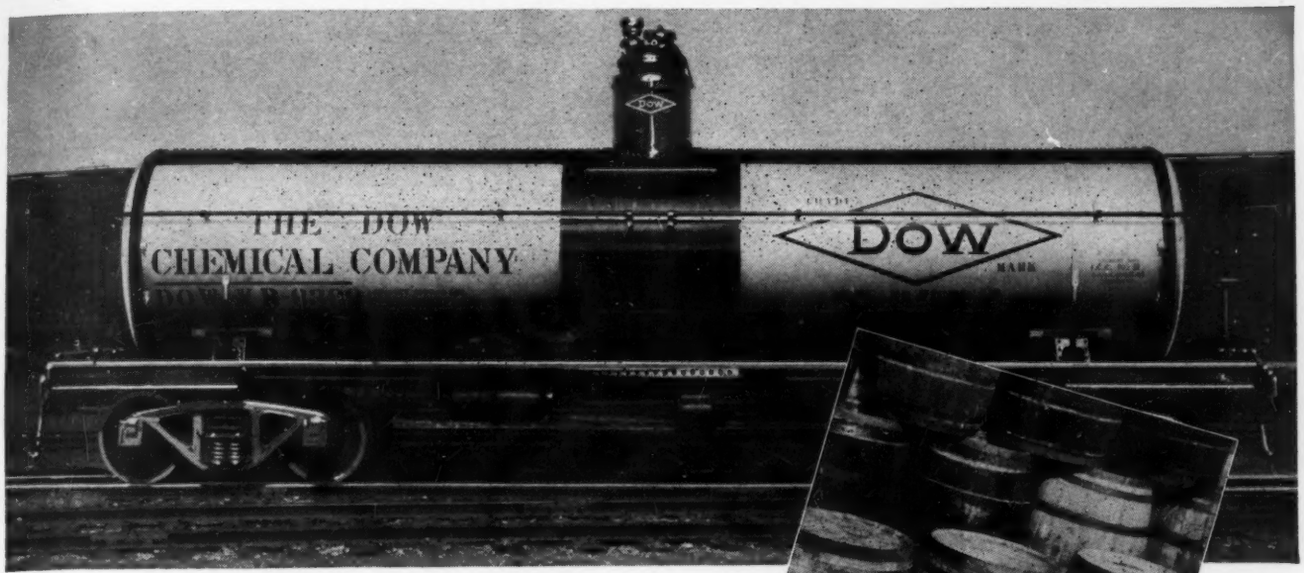
Members of the committee, particularly the electrical industry's representatives, must find it difficult to get excited over the importance of grounding effects, when water works operators have not been sufficiently so to file case complaints through A.W.W.A.'s branch of the committee. Now with the matter thrown squarely up to the water works representation it is important that water operators file complaint cases through A.W.W.A. headquarters without delay. Further, that those water works with laboratory facilities cooperate in the important phase of field observations and field testing.

In looking critically at the history of grounding opposition, one can not dodge the fact that the picture appears so far to be one of more "smoke" than actual "fire"; and this question of "where's the fire?" must also be in the minds of many of the joint Research Committee.

It seems distinctly up to water works operators to assist in clearing up the question without delay, or else forever to hold their peace. The committee is tooled and ready to complete its job. What will operators do to facilitate securing the real picture of "What cost grounding?"; and, in improving a practice which is definitely needful of improvements and refinements.

DOW FERRIC CHLORIDE

A Solution to Sewage Treatment Problems



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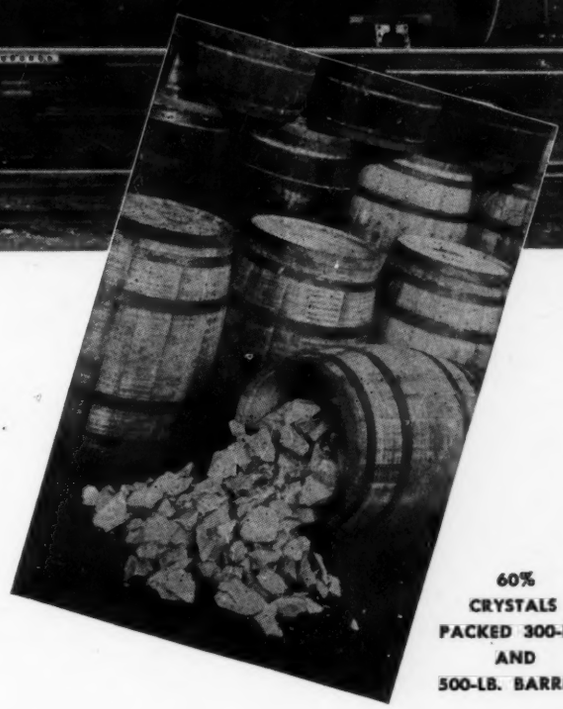
Dow Ferric Chloride is supplied in 38-45% solution in tank cars and 60% crystals packed in 300 and 500 lb. barrels. Dow Technical Service covering design and operating problems of sewage disposal plants is available to engineers. Write today for full information.



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Perchloron

SYSTEM OF SAFETY STAND WATCH OVER *Your Community*

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The purity of this liquid chlorine is a great advance, made possible by a new purifying process developed by Pennsylvania Salt. Specially designed fractionating equipment substantially removes trouble-making impurities, and their cumulative effect over long periods of operation has been minimized.

In addition an improved analytical method of evaluating liquid chlorine as to such impurities was developed as a means of manufacturing control. This is an extra safeguard for your protection, a further assurance of trouble-free operation of your equipment.

You will appreciate Perchloron, the second safety-product, in case your normal supplies of liquid chlorine are ever cut off by some unforeseen event—such as a flood, hurricane, blizzard, or conflagration. Perchloron is a dry, free-flowing granular material containing more than 70% available chlorine. It dissolves readily in water. Stable, concentrated, uniform. Packed 9 handy-sized cans to the case, each can with new Kork-N-Seal cover. Also in 75-lb. drums.

Perchloron is used, not only for emergency chlorination, but for sterilizing new mains, for clear wells and filters, and for swimming pool sanitation. Write for free illustrated booklet. Pennsylvania Salt Manufacturing Company, Widener Building, Philadelphia, Pa.—New York • Chicago • St. Louis • Pittsburgh • Tacoma • Wyandotte.

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COMPLEX or SIMPLE

All Joints look alike to this* INGOT *Form Compound

Tegul-MINERALEAD is used in pipe from 2" diameter up to the largest—and in every size in between. It is easy to use; no skilled labor required; no caulking or deep bell holes needed ● Correctly compounded at our plant, no amount of jolting in transit can change composition en route to you ● The 10 lb. unit is easy to handle, ship and store; and impervious to rain and flood ● Tegul-MINERALEAD offers the conceded advantages of sulfur base compounds without their handicaps ● Initial leakage heals quickly, permitting immediate clean-up ● For further information write the ATLAS MINERAL Products Company of Penna., Mertztown, Pennsylvania.

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CONSTRUCT—DESIGN—SUPERVISE—UNDERPINNING AND FOUNDATION CO. 155 EAST 44TH ST.—NEW YORK

For Incineration of SEWAGE SLUDGE, SCREENINGS, GROUND GARBAGE

Operation is without auxiliary fuel—odorless!

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NEW YORK, N. Y.

EQUIPMENT NEWS

Grit "De-organization"

● Coining what we believe to be a descriptive term for effective grit cleansing, "de-organization" signifies much more than mere grit washing. It is intended to denote effective loosening and sweeping out of clinging organics from sewage grit.

We have learned from experience that sticky films can not be successfully removed from sand grains of water filters without scouring action, such as is being provided by one of the modern methods of bed agitation. Such an effect causes the grains to become members of a sort of "Mutual Scrubbing Society". With this fact before us it is not difficult to appreciate that to hydraulically remove grease and other sticky organics from sewage grit, effectively, requires *real* scrubbing action in combination with the wash.

To peptize or emulsify a tenacious water-repellant grease film is no simple task, but Jeffrey Mfg. Co. claims that their recently developed process of grit-jigging accomplishes the trick more perfectly than has ever before been attained in a mechanical grit-washing process.

Grit-jigging is accomplished in Jeffrey's "JIGRIT," especially developed for scouring and hydraulical separation of organics from grit by utilizing the principle employed in cleansing and concentration of ores. It is reported to reduce 4.5% volatiles in the dirty grit to less than one-half of 1% in the cleaned grit—effecting a 91% "de-organization" with a reported grit loss of negligible proportions.

Encouraged by the successful accomplishments of the early "JIGRIT" units, constructed for large works, Jeffrey has now developed a Junior Model for the smaller plants. The new, less expensive, model is "JIGRIT" No. 1, which has all of the features of the larger (No. 4) model, except that the full automatic feature has not been incorporated. It is power driven but manually controlled, and operates in conjunction with a Jeffrey V-bucket grit collector mechanism.

We regret the lack of a photograph of the Junior "JIGRIT" unit to clarify this announcement, and must refer the reader to the manufacturer for illustrated literature, which effectively describes this smaller model mechanical grit scrubber. The address is Jeffrey Mfg. Co., 996-99 North 4th St., Columbus, O.

Crane Well Pumps

● Crane Co. have recently invaded the water pump field with the introduction of a new line of moderate capacity shallow and deep well pumps.

Sleekness and simplicity of design and parts are features of the new Crane pumps. In the deep well model (D-60) there is a load balancing cylinder and silent herringbone gears contributing to quiet, economical operation.

For descriptive literature write Crane Co., Chicago.

Compact Recording Thermometer

● The Jas. P. Marsh Corpn. of Chicago are offering a small, compact, portable, high-quality recording thermometer at low cost.

In the new Marsh No. 70 "Serviceman" Recorder a bi-metallic spiral of advanced design is used in the temperature recorder. An outstanding feature is the pen and pen arm. The arm has a friction hinge which permits it to be swung clear of the chart for quick and convenient chart replacement. The case is smooth, cast-aluminum, handsomely finished in satin black, with highly polished chrome bezel. A wide variety of charts in Fahrenheit or Centigrade are available.

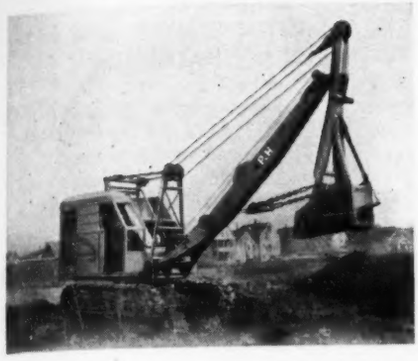
Fully descriptive literature is available upon request to Jas. P. Marsh Corpn., 2073 Southport Ave., Chicago.

Unbreakable Breathing Dessicator

● Christened the "Dessicooler" the "breathing" (dry-fill) dessicator is compact light and unbreakable. It is constructed of aluminum and contains dry granular activated alumina, as the dessicating material. Being of aluminum, or aluminum alloy, the cooling is rapid. To avoid partial vacuum and lid sticking the top is designed to permit "breathing" upon cooling.

The manufacturer claims efficiencies at least those of the cumbersome heavy glass dessicators, and without the disadvantages of these old style dessicators. For descriptive booklet, write the well known laboratory equipment house—Fisher Scientific Company, 711 Forbes Street, Pittsburgh,

A New Trench Hoe Easily Converted for Seven Types of Service



● The Harnischfeger Corporation of Milwaukee announces the new P&H Model 255 Trench Hoe—a ¾-yard machine built for a wide range of materials-handling work. In addition to its use as a Trench Hoe, this machine can be converted into a shovel, dragline, clamshell, crane, skimmer scoop or pile driver. It will dig to a depth of 18 feet and cut a trench 32, 34, 36, or 38 in. wide.

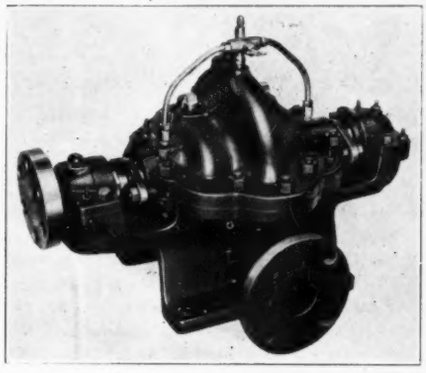
Combining rapid line speeds with ample power, the Model 255 is equipped with tractor-type crawlers for fast, easy travel. It has three forward speeds ranging from ⅝ to 2½ miles per hour. There's a change of pace in digging, too, to meet every need for snappy power in easy or tough going. This machine is equipped with a swivel-type hoe stick pivot bearing which is designed to absorb shocks by eliminating twists in the boom. Easily convertible for shovel use, the Model 255 is built of all-welded alloy steels throughout for greater strength, more resistance to shock loads and withal, an appreciable reduction in weight.

For descriptive literature or further information address the Harnischfeger Corporation, 4400 W. National Avenue, Milwaukee, Wis.

Ball Bearings Now Standard On Allis-Chalmers Pumps

● Allis-Chalmers Mfg. Co. announce the inclusion of ball-bearings as standard equipment on nearly all its line of single stage pumps, where peripheral speeds are not excessive. However, since many engineers still prefer sleeve bearings all bearing housings are designed so that either sleeve or ball bearings may be accommodated.

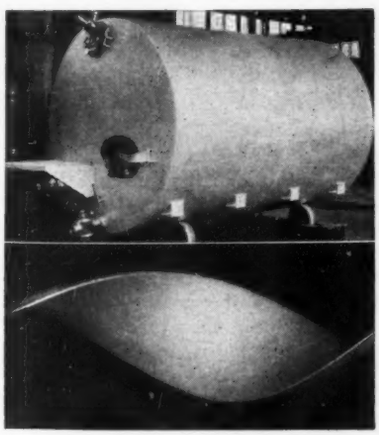
The new bearings are of the single row deep-groove type (on both ends of the pump) in cast iron adapters arranged for grease lubrication. These same type of bearings have long been successfully used in A.C. motors, which have even much



heavier loads than ever experienced with centrifugal pumps. However, if double row ball bearings are preferred, under some specific circumstance, the new design permits this type to be used at but slight extra cost.

The use of an adapter inside the main housing provides a sort of double seal which prevents grease from leaking to the exterior of the pump. When the pump is dismantled the adapters remain on the shaft, keeping the bearings sealed and protected. For descriptive literature write Allis-Chalmers Mfg. Co. (Pump Div.), Milwaukee, Wis.

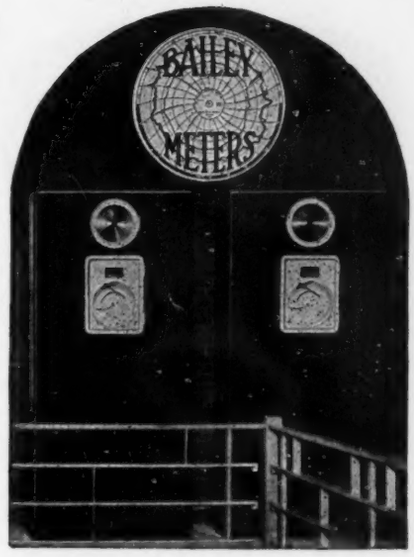
"Silver-Ply" Stainless Steel



● Stainless clad steel sheets and plates, known as "Silver-Ply", which combine the corrosion resistance of stainless steel with many of the desirable properties of mild steel, are now being marketed by the Jessop Steel Co. of Washington, Pa. They are suitable for storage tanks and other equipment used in the processing and handling of chemicals and for other purposes at water works and sewage disposal plants wherever corrosion is encountered. A typical vessel fabricated from "Silver-Ply" is shown in the upper part of the illustration.

"Silver-Ply" may be bent, spun into deep heads, deep drawn, drilled and otherwise worked with greater ease than solid stainless steels. "Silver-Ply" is manufactured by a patented process which assures a strong, uniform, oxide-free weld between the stainless cladding and the mild steel backing. The strength of the bond is illustrated in the lower part of the cut, which shows a strip of "Silver-Ply" twisted into a spiral shape without any separation of the composite metals. The usual sheet or plate of "Silver-Ply" consists of 20% stainless steel and the balance mild steel.

Complete information and copy of specifications will be sent upon request to Jessop Steel Co., 590 Green St., Washington, Pa.



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● MODERN APPEARANCE

Regardless of whether your problem calls for the use of a Venturi Tube, Weir, or Flume, you can depend on Bailey Meter Company to design and construct both the primary element and the register for maximum accuracy.

A vast amount of experience gained from thousands of installations of metering equipment, together with extensive experimental work in our own hydraulic laboratory and in the laboratories of the Ohio State University, Cornell University, Case School of Applied Science and other institutions, is back of every Bailey Primary Element.

The reliability of Bailey Meters and Recorders is attested to by the fact that thousands of dollars worth of steam and water are sold monthly and billed solely on the basis of readings from Bailey Meters.

No small share of the accuracy and reliability of Bailey Meters is due to the conservative engineering policy of the Company. New ideas and designs are not offered for sale until they have been thoroughly tested both in the laboratory and in actual service.

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Write for your copy of Bulletins No. 301 and 302, describing Bailey Fluid Meters for steam, liquids, gases, sewage, sludge, and compressed air.

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SOLUTION or CRYSTAL?

FOR SLUDGE CONDITIONING—Ferric Chloride is accepted as the agent most efficient from the standpoint of performance and cost.

FOR COAGULATING SEWAGE—Ferric Chloride provides an inexpensive and effective method of dealing with plant overloads.

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Philadelphia Gloversville, N. Y.

HELP WANTED

Wanted: Sewage Plant Superintendent to supervise operations and do analytical work. Salary $150.00 a month for half time. Other supervisory work available to increase income. Outline qualifications by letter to H. C. Y., % "Water Works and Sewerage," 155 East 44th Street, N. Y. C.

POSITION WANTED

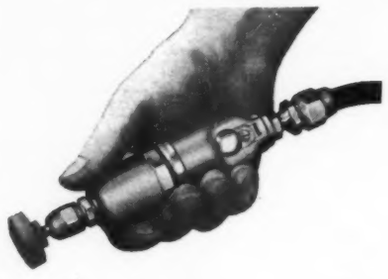
By M. I. T. Graduate: Chemical Engineer. Age 42 yrs. Married. Experience—15 yrs. selling and executive duties, handling well known line of water works equipment. Also experience as water works superintendent; and qualified as sewage plant operator. References gladly furnished. "C. H. H." % Water Works & Sewerage, 155 East 44th St., New York City.

As Sewage Treatment Plant Operator. Four years experience as Chief Operator. Able to make all laboratory tests. Well acquainted with the mechanical and gasburning equipments. Not afraid of work or dirty hands. May I have the opportunity of attempting to fill your requirements. Can furnish the best of references both state and local. Address L. H., % Water Works and Sewerage, 330 S. Wells St., Chicago, Ill.

Sanitary Chemist—Desires position in a sewage or waterworks plant. Record—Chief Chemist of Chemical Treatment Sewage Plant, 2 years; Chemist and Bacteriologist for Illinois State Water Survey, 2 years; U. of Illinois graduate—B.S. in Chemistry; graduate in sewage—2 yrs. Age—28; married; available at once; go anywhere; reasonable salary.—Address "S.C.," c/o Water Works & Sewerage, 155 East 44th St., New York.

New Portable Pneumatic Grinder

● A new rotary air grinder for small-wheel work, known as the Thor "Bantam" has just been announced by the Independent Pneumatic Tool Company of Chicago. As shown in the illustration, it is but 5½ inches long and weighs only 18 ounces. This small size and light weight



makes it exceptionally easy to handle for even the most delicate precision work.

Operating at a free speed of 14,000 r.p.m. the "Bantam" is suitable for use with a wide variety of accessories. Mounted abrasive wheels in all shapes and sizes from the smallest pointed wheel up to 1½" diameter round wheels can be used efficiently. Other accessories such as rotary files and steel cutters, sanding discs, wire brushes, saw blades, and buffing and polishing wheels can also be used, making the "Bantam" a highly versatile tool for hundreds of jobs—in meter shops particularly.

For further information ask for Bulletin P-20. Address, Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.

And Now a Rubber Filter Cloth

● U. S. Rubber Co. announces an interesting porous rubber sheeting known as "Multipore" which is reported to be highly suitable for filtration. It is being used in the chemical industry for such purpose.

"Multipore" is made from latex by a patented process which produces a uniform porous sheet containing many minute uniformly spaced holes. It offers the advantages of sustained flexibility and elasticity along with resistance to attack by corrosive liquids. It is produced in varying porosity—having from 1100 to 6400 holes per square inch, with pore diameters from 4/1000ths to 12/1000ths of an inch.

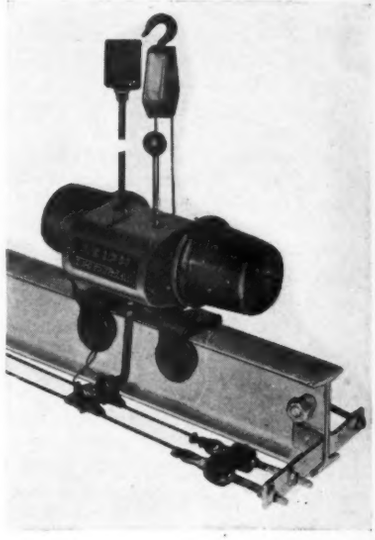
This new rubber filter "cloth" may find a decided use in connection with sludge dewatering and filtration of effluents or industrial wastes, in conjunction with chemical or biological treatment processes. The most interesting aspect is its permanent elasticity and resistance to attack by chemicals, mold or fungus growths which attack or blind filter cloths of cotton or wool.

For literature and further information on this new product, address your inquiry to U. S. Rubber Company, (Mechanical Goods Div.), 1790 Broadway, New York City.

New "Speedway" Hoist

● The "Speedway," a light weight low cost electric-hoist, has been added to their present line by the Wright Manufacturing Division of the American Chain & Cable Company, Inc., York, Pa.

Hoisting capacities range from 250 pounds to 750 pounds, and hoisting speeds 15 feet to 43 feet per minute. The Wright Speedway Electric Hoist standard construction includes fully enclosed ball bearing motor, anti-friction bearings, cut alloy steel spur gears, multiple disc solenoid brake, push button control, pre-formed hoisting cable and other quality features.



The "Speedway" Hoist is available in three types, for lug suspension or hook suspension, or mounted on trolley. For descriptive literature write American Chain and Cable Co., Inc., York, Pa.

Improved Floor Resurfacer

● Improved "Ruggedwear" Floor Resurfacer is announced by Flexrock Company of Philadelphia. Introduced about 5 years ago this material for patching or complete resurfacing of damaged or worn floors of concrete, wood, etc., was first improved by the addition of toughening cellulose, which also added resiliance to the surfacer.

Now, a further improvement is the addition of a Montmorillonite (the discover's name for a platicizing clay) to increase its covering capacity per pound, and economy therewith. Another genuine asset, resulting from the new formula, is that mixing requires less time and labor, a more uniform motar results. Trowelling "Ruggedwear" to the desired smooth feather edges in floor patching is simpler of attainment, as is perfect bonding. For complete covering of rough or worn floors a ½ inch depth is recommended for dependable and resiliant long-wear surfacing.

For further details or specific recommendations, write Flexrock Co., 2301 Manning St., Philadelphia, Pa.

WITH THE MANUFACTURERS

Carl Lager Dies

Rose to Presidency of Morris Machine Works

Carl Lager
(1869-1939)

● Carl Lager, president of Morris Machine Works, of Baldwinsville, N. Y., died July 17th at his summer home in the Adirondacks.

A little less than fifty years ago he joined this pioneering firm of centrifugal pump manufacturers as an engineer. He successively became its Chief Engineer, later general manager and, in 1935, its president.

Born and educated in Sweden, he came to America in 1887 to attain a reputation as one of this nation's foremost designers of pumping machinery, steam engines and hydraulic dredging machines, and has to his credit numerous improvements in Morris pumps long used in water works, sewerage and drainage systems.

By the American Society of Mechanical Engineers, of which he was a 46-year member, he was honored by being made a life member. He was a tireless worker and an inspiration to those who worked under this brilliant engineer.

Columbia Alkali Executive Sales Offices Moved to New York City

● The Columbia Alkali Corporation announce that the Executive Sales Offices of the Corporation were moved on Sept. 1st from Barberton, Ohio, where the main works of the company are located, to New York City.

The Executive Sales Offices are now located at 30 Rockefeller Plaza, New York City.

D. W. Haering & Co. Move Offices to Facilitate Service

● D. W. Haering, President of the firm bearing his name, announces that all of the uptown office space of this company at 3408 W. Monroe St., Chicago, is being revamped into laboratories to provide more facilities for attacking problems and conducting research. Executive and accounting offices are being established at the company's plant, located at 2308 So. Winchester Ave., Chicago, where increased space needed for expansion has been provided.

Starting in 1931 as virtually a one-man ogarnization, for production and sale of glucoside derivatives for scale and corrosion control, D. W. Haering & Co. has grown to an internationally active and successful corporation, with officers and representatives in most principal cities in the United States and Canada.

Pittsburgh Meter Establishes European Agency

● Col. W. F. Rockwell, President of Pittsburgh Equitable Meter Company, has announced the appointment of the Anthony Bruyaux Co. of Brussels, Belgium, to be sales agents for Pittsburgh Equitable products in Belgium, Holland, and France.

This company has for some time handled the sale of valves for the Merco Nordstrom Valve Co., a Pittsburgh Equitable subsidiary and the recent additional appointment constitutes something of a success story.

Hooker Co. Moves Executive Offices to Niagara Falls

● Announcement has come from the Hooker Electrochemical Co. that effective August 21st, its Administrative, Sales and Accounting Headquarters, together with personnel, were transferred from New York City to Niagara Falls, N. Y. A local office will, however, be maintained in New York City at 60 East 42nd Street (Lincoln Building), the former headquarters address.

A-C Opens Branch Offices in Louisville and La Porte

● Allis-Chalmers Mfg. Co. announce the establishment of new branch offices in Louisville, Ky., and La Porte, Ind.

W. E. Kercheval will be in charge at Louisville (U. S. Trust Bldg.) and B. L. Margeson takes charge of the new La Porte offices. He leaves the Rockford, Ill., office, which will now be in charge of T. J. Brentzman, transferred from the Chicago office.

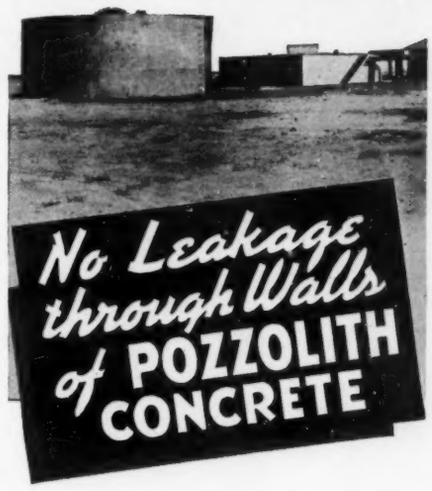
EISNER APPOINTED CHIEF ENGINEER FOR CLAY PIPE ASSOCIATION

● Benjamin Eisner has resigned as chief engineer of the New York World's Fair, to accept appointment as chief engineer of the Clay Sewer Pipe Association of Pittsburgh.

A Cornell graduate (1920), Mr. Eisner served as assistant engineer with the Passaic Valley (N. J.) Sewerage Commission and later as sanitary engineer for the city of Paterson, N. J. In 1928 he entered into consulting practice as a partner of William Gavin Taylor, and in 1935 was appointed chief sanitary engineer of the the New York World's Fair, to take charge of design and installation of the million dollar net-work of water mains, sewers, and drains in the "World of Tomorrow."

In his new connection Mr. Eisner will serve the recently formed trade association of Clay Pipe Manufacturers as adviser on engineering problems, and will also direct the work of its promotional department.

POZZOLITH



"We were much pleased with the workability and denseness of the concrete obtained," reports Mr. H. R. F. Helland, Construction Engineer on the Sewage Treatment Plant at Pecos, Texas. "When the structures were filled with water for test, there was no leakage through the walls. This was gratifying as a similiar concrete structure built a few years ago with the same type aggregates had many leaks."

Durable, watertight, corrosion resisting concrete can be easily and economically attained with Pozzolith. Interesting performance data is available . . . send for it today.

SEND FOR THIS IMPORTANT TEST!

Freezing and thawing tests on Pozzolith concrete made by a leading university laboratory — authority in concrete research — show concrete durability is tripled by Pozzolith. Your copy of this report sent free upon request.

Send for full information to

THE MASTER BUILDERS COMPANY
Cleveland, Ohio

In Canada: THE MASTER BUILDERS Co., Ltd.
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MASTER BUILDERS

LIQUID CHLORINE
"The Great Purifier"

AT the turn of the century, when Chlorine was first introduced as a water purifying agent, there ensued a widely publicized lawsuit to prevent its use. Curiously enough, instead of preventing the use of liquid chlorine, the facts of the case so clearly demonstrated Chlorine's value for water purification that all doubt was forever allayed in the public mind.

Today, over 75% of the drinking water of North America is chlorinated and the typhoid rate stands at the lowest in history. "The great purifier" has done its job well. Its merits require no further selling.

But the test of a service is its availability in times of emergency. Solvay's new "Big 3" Liquid Chlorine Service is designed to fulfill that test. Modern plants, the latest production equipment, a well equipped Technical Service Division assure State and Municipal authorities of quick and adequate supplies of Solvay's Liquid Chlorine and good advice and technical assistance when it is required.

Solvay Liquid Chlorine shipments are now routed from Syracuse, New York; Hopewell, Virginia; and Baton Rouge, Louisiana. Your inquiries on Solvay Liquid Chlorine are cordially solicited. Please write to the nearest branch office listed below.

SOLVAY SALES CORPORATION

Alkalies and Chemical Products Manufactured by The Solvay Process Company

40 RECTOR STREET **NEW YORK, N. Y.**

BRANCH SALES OFFICES:

Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, Syracuse, Indianapolis

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LIQUID CHLORINE

MEETINGS SCHEDULED

Sept. 12-15—MONTREAL, QUEBEC (Hotel Windsor)
New England Water Wk's. Ass'n. (Annual Convention). Sec'y, Frank J. Gifford, 613 Statler Bldg., Boston.

Sept. 14-15—RAPID CITY, S. D. (Hotel Alex Johnson)
South Dakota Water and Sewage Works Conference. Sec'y. W. W. Towne, State Board of Health, Pierre, So. Dak.

Sept. 15—WILDWOOD, N. J.
South Jersey Assn. Water Superintendents (4:00 P.M.). Sec'y., Walter Spencer, 2707 Bethel Ave., Merchantville, N. J.

Sept. 16—LAKE WEOWN, N. J. (The Grove)
New Jersey Sewage Works Association (1st Annual Clambake). Sec'y. John R. Downes, Bound Brook, N. J.

Sept. 18-19—DENVER, COLO. (Shirley-Savoy Hotel)
Rocky Mountain Section A.W.W.A., Sec'y., B. V. Howe, State Office Bldg., Denver, Colo.

Sept. 18-19—OAKLAND, CALIF.
California Sewage Works Association. Sec'y. Treas., R. R. Ribald, 701 City Hall, Oakland, Calif.

Sept. 18-20—JOHNSTOWN, PA. (Hotel Fort Stanwix)
Western Pennsylvania Section A.W.W.A., Sec'y., E. P. Johnson, 418 Flannery Bldg., Pittsburgh, Pa.
Meeting Jointly with
Western Section Pennsylvania Water Works Operators Ass'n. Sec'y I. M. Glace, 22 So. 22nd St., Harrisburg, Pa.

Sept. 20-22—LANSING, MICH. (Olds Hotel)
Michigan Section A.W.W.A. Sec'y. M. N. Gerardy, Water Board Bldg., Detroit, Mich.
Meeting Jointly with
Michigan Conference Water Purification. Sec'y-Treas., R. J. Faust., Michigan Dept. Health, Saginaw, Mich.

*Sept. 22-23—DICKINSON, N. D.
North Dakota Water & Sewage Conference. Sec'y-Treas., L. K. Clark, Bismarck, N. D.

Sept. 29-30—WINCHENDON, MASS. (Toy Town Tavern)
New England Sewage Works Association. Sec'y-Treas., LeRoy W. VanKleeck, State Dept. of Health, Hartford, Conn.

Oct. 3-4—TOLEDO, O. (Commodore Perry)
Ohio Conference on Water Purification. Sec'y. Thos. R. Lathrop, State Dept. of Health, Columbus, O.

Oct. 5-6—TOLEDO, OHIO (Commodore Perry Hotel)
Ohio Conference on Sewage Treatment. Sec'y-Treas., B. M. McDill, Dept. of Health, Columbus, Ohio.

Oct. 5-6—READING, PA. (Berkshire Hotel)
Four States Section A.W.W.A. Sec'y-Treas., Carl A. Heckmer, Washington Sub. San. District, Hyattsville, Md.

Oct. 6-7—OLEAN, N. Y. (Olean Hotel)
New York State Sewage Works Association. Sec'y-Treas., A. S. Bedell, State Dept. Health, Albany, N. Y.

Oct. 9-11—PITTSBURGH, PA. (Hotel Wm. Penn)
American Public Works Association, Exec. Director, Frank W. Herring, 1313 East 60th St., Chicago, Ill.

Oct. 12-13—CHICAGO, ILL. (Congress Hotel)
Central States Sewage Works Ass'n. Sec'y., W. H. Wisely, State Sanitary Board, Springfield, Ill.

*Oct. 12-14—MORGANTOWN, W. VA. (Morgan Hotel)
West Virginia Section A.W.W.A. & West Virginia Conference on Water Purification (Joint Meeting). Sec'y.-Treas., J. B. Harrington, State Dept. Health, Charleston, W. Va.

Oct. 16-19—DALLAS, TEXAS (Adolphus Hotel)
Southwest Section A.W.W.A. Sec'y-Treas., Lewis A. Quigley, 3320 West Berry St., Fort Worth, Texas.

Oct. 17-20—PITTSBURGH, PA. (Hotel William Penn)
American Public Health Association. (68th Annual Meeting.) Exec.-Sec'y., Dr. Reginald M. Atwater, 50 West 50th St., New York City.

*(NOTE: Change in dates from previous listing.)

Oct. 18-20—Atlantic City, N. J. (Hotel Haddon Hall)
Pennsylvania Water Works Association. (Annual Meeting.) Sec'y., F. Herbert Snow, 507 Telegraph Bldg., Harrisburg, Pa.

Oct. 20-21—Atlantic City, N. J. (Claridge Hotel)
New Jersey Section A.W.W.A. Sec'y., H. N. Lendall, Rutgers University, New Brunswick, N. J.

Oct. 19-20—Hamilton, Ont. (Royal Connaught Hotel)
Canadian Institute on Sewage & Sanitation. Sec'y-Treas., A. E. Berry, Ontario Dept. of Health, Parliament Bldgs., Toronto, Ont.

Oct. 25-28—San Francisco, Calif. (Fairmont Hotel)
California Section A.W.W.A. Sec'y-Treas., Burton S. Grant, Civil Engr., Bureau of Water, Los Angeles, Calif.

Oct. 30-Nov. 1—Oshkosh, Wisc. (Hotel Raulf)
Wisconsin Section, A.W.W.A. Sec'y-Treas., Leon A. Smith, Supt., Water Dept., City Hall, Madison, Wisc.

Nov. 2-3—Utica, N. Y. (Utica Hotel)
New York Section A.W.W.A. Sec'y., R. K. Blanchard, 50 West 50th St., New York City.

Nov. 6-8—Charlotte, N. C. (Hotel Charlotte)
North Carolina Section A.W.W.A., Sec'y., R. S. Phillips, 206 Dacian Ave., Durham, N. C.

March 20-22 (1940)—Trenton, N. J. (Hotel Stacey Trent)
New Jersey Sewage Works Association (Silver Anniversary). Sec'y-Treas., Paul Molitor, Jr., P.O. Box 374, Morristown, N. J.

CATALOGS AND LITERATURE

"Saunders Acid Proof Valves" are described and pictured in a new bulletin from Hills-McCanna Co. of Chicago. In addition to their diversified adaptation in the chemical industry these diaphragm pinch-type valves have been very generally employed in water and sewage plants in chemical handling and feed lines. The Saunders ,Patent) valve is also employed as a cutless long lived valve on water and air lines. Particularly adaptable are these valves for effective throttling without seat cutting by suspended particles and high velocity flows. Cross sectional views reveal the extreme simplicity of these trouble free valves. Pictures of typical water works and sewerage applications add interest. (See address below.)

"Chemical Proportioning Pumps" by Hills-McCanna are presented in a companion bulletin to that above. The several types of these pumps, long successfully used in the process industries for exact precision proportioning of chemicals against high or low heads, are now offered in the water and sewage fields. Four types are illustrated in a praiseworthy manner, with exact specifications given for each. Capacities starting at 2 gal./hr. run to 1500. Also illustrated in this bulletin is a centrifugal pump for corrosive liquids. For either of these two companion bulletins, write Hills-McCanna Co., 2349-59 Nelson St., Chicago, Ill.

"ROTAX Control by Foxboro" is presented in a new bulletin from The Foxboro Co., which in 32 pages of illustrated text explains the technical details of construction and operation of ROTAX Control Systems (with signalling, indicating and recording devices)

(*Continued*)

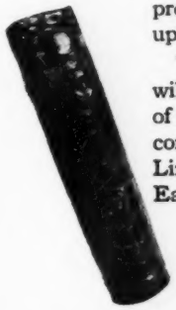
Arrowhead Grating & Treads
Engineers' Handbook sent on request
ARROWHEAD IRON WORKS, Inc.
431 W. 5th St., Kansas City, Mo.

FOR EFFECTIVE PIPE PROTECTION
COATINGS must be WRAPPED with ASBESTOS FELTS

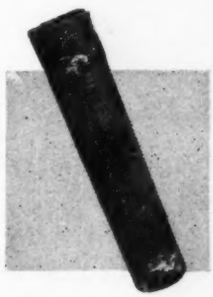
● Here's a money-saving tip to waterworks engineers. More than 25 years' experience in the oil and gas industries has proved many types of ferrous pipes must be protected by a corrosion-resistant coating. What's more, the coating must be reinforced or shielded with a strong, durable wrapping to prevent distortion and abrasion. And, for that service, asbestos—in the form of J-M Pipe-Line Felts—has proved the ideal material.

Because the asbestos fibers are inorganic and non-tubular, J-M Asbestos Felt cannot support capillary action. Tough and durable, it reinforces the coating against earth load and soil stress. And, because it is exceptionally resistant to the corrosive action of soil acids and alkalis, this durable felt gives efficient protection for the coating . . . helps keep upkeep costs to a minimum.

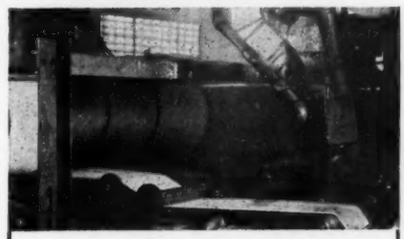
You'll be interested in the whole story. It will show you why more than 30,000 miles of pipe are operating at low cost under severe conditions. Write for the J-M Asbestos Pipe-Line Felt brochure to Johns-Manville, 22 East 40th Street, New York, N. Y.



UNWRAPPED BITUMINOUS COATING after exposure to clay-content soil. Soil stress has destroyed much of the protective coating.



THE SAME COATING, under the same conditions, but wrapped with J-M Asbestos Felt. The wrapping shows no signs of breakdown . . . the coating underneath is practically as good as new.

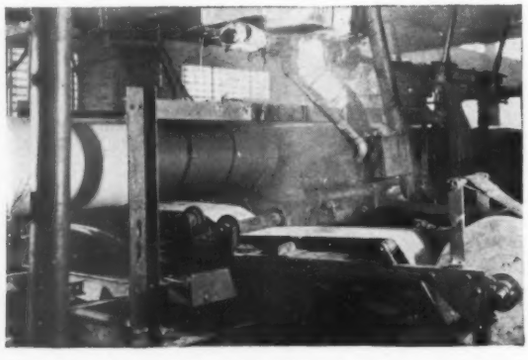


YOU CAN PURCHASE pipe from the steel-pipe mill coated with any standard coating material and wrapped with Johns-Manville Asbestos Felts. Or the same operation can be performed in your own yard by portable wrapping equipment supplied on a rental basis. Write Johns-Manville, 22 East 40th Street, New York, N. Y., for further information.

JOHNS-MANVILLE JM
ASBESTOS PIPE-LINE FELTS

THE
HILL-HUBBELL
PROCESS
is really
"FACTORY
APPLIED"
PIPE PROTECTION

A glance backward through the years tells us that nearly everything used today was, at one time, made by hand. At one time all Lining, Coating-and-Wrapping of STEEL PIPE was done by hand on the job. Just as articles of all kinds are better "factory made" so is Lining, Coating-and-Wrapping done more efficiently by the HILL-HUBBELL "factory applied" method. Time marches on, and the old obsolete "hand made" way is replaced by the more efficient MECHANICAL way. Many Engineers who have seen the HILL-HUBBELL MECHANICAL—INDOOR—Process say it is FAR superior.



The HILL-HUBBELL "Factory Applied" method of Coating-and-Wrapping STEEL PIPE

Write for Copy

The Book of PIPE PROTECTION describes in detail how STEEL PIPE is MECHANICALLY Lined and Coated-and-Wrapped at the Mills under ideal conditions. Use your letterhead and write for a copy.

GENERAL PAINT CORPORATION
HILL, HUBBELL & CO. • Division • Cleveland, Ohio
• EXPORT OFFICE SAN FRANCISCO, CALIFORNIA, U. S. A. •

for the control of (1) Liquid Levels (water and sewage); (2) Temperature (sludge digesters, buildings, incinerators, etc.); (3) Pressures (water, air, etc.); (4) Humidity; (5) Refrigeration. The versatility of ROTAX Control, in several combinations, is explained graphically by showing eight of the many possible combinations in automatic pumping control at water and sewage works—with typical installations sketched and photographed.

Instruments for time operation control, now increasingly employed in sewage treatment, are also presented as are light and sound signals and solenoid valves. For Bulletin 184-3 write The Foxboro Co., Foxboro, Mass.

"Heat Recovery"—Is discussed in a 32-page technical publication from Davis Engineering Corp. of Elizabeth, N. J., which deals with the recovery and utilization of heat from internal combustion engines through "Paracoil" equipment manufactured by this firm, and for which it is well known in the industrial field. Typical units employed in heat exchange practice are illustrated by line drawings, and examples of exchange and recovery calculations are given. Heat balance comparisons are given and the important question, with an example problem, is answered in understandable explanatory steps—"Paracoil" Exhaust Waste Heat Boilers and Jacket Water Heat Exchangers being featured. Then follow recommendations of interest to engineers who may be contemplating the installation of gas or Diesel engines at sewage plants. For a copy of "Heat Recovery" write Davis Engineering Corp., Elizabeth, N. J.

"Water Lubricated Pumps" are presented in a new bulletin by Peerless describing an improved type of water lubricated deep well turbines. Printed in three colors, an excellent reproduction of a cutaway section of the entire pump assembly reveals the distinctive features of Peerless pumps, including the method of sealing the impellers by the exclusive double seal of hard rubber. Completely water lubricated, no oil is employed below surface in this type pump, the entire shaft running in Goodrich (cutless) fluted rubber bearings—another exclusive Peerless feature. These bearings are rigidly fixed in all-bronze spiders to eliminate vibration, whip, and corrosion difficulties. For a copy write Peerless Pump. (Div. of Food Machinery Corp.), 301 W. Avenue 26, Los Angeles.

"Solution Feeder and Wash Troughs" are the subject of new bulletins from International Filter Company.

Bulletin 360 pictures and describes a new plunger-diaphragm type small chemical feeder for measuring and and feeding solutions up to 2.75 gals/min. The unique principle is the actuation of the pumping (feeding) diaphragm by hydraulic pressure applied over the entire face of the actuating side of the flexible diaphragm. The feed rate is adjusted by stroke length and speed of plunger entering the chamber filled with the actuating transmission liquid. The scheme eliminates

(*Continued*)

EDSON'S NEW HAND PUMP

Smallest Diaphragm Pump Made, 2" Suction Open Discharge. Capacity 1400 G.P.H. Weight 50 lbs.

THE EDSON CORP'N, 49 "D" Street So. Boston, Mass.
NEW YORK: 142 Ashland Pl., Brooklyn
CHICAGO: 1064 Peoples Gas Building
Catalog "T" Gives Full Data, Also Edson Hand and Power Pumps, Suction Hose and Pump Accessories

diaphragm strain and fatigue, insures long life and sustained accuracy of the feeder.

Bulletin 950 describes cast-iron and steel wash-troughs for filters. Discussed, are the fundamentals of trough design, to preclude long travel of suspended dirt to the troughs, and suggests trough spacing and dimensions for best results.

For either or both Bulletins 360 (feeders) and 950 (troughs) write International Filter Company, 325 West 25th Place, Chicago. (Note new Infilco address).

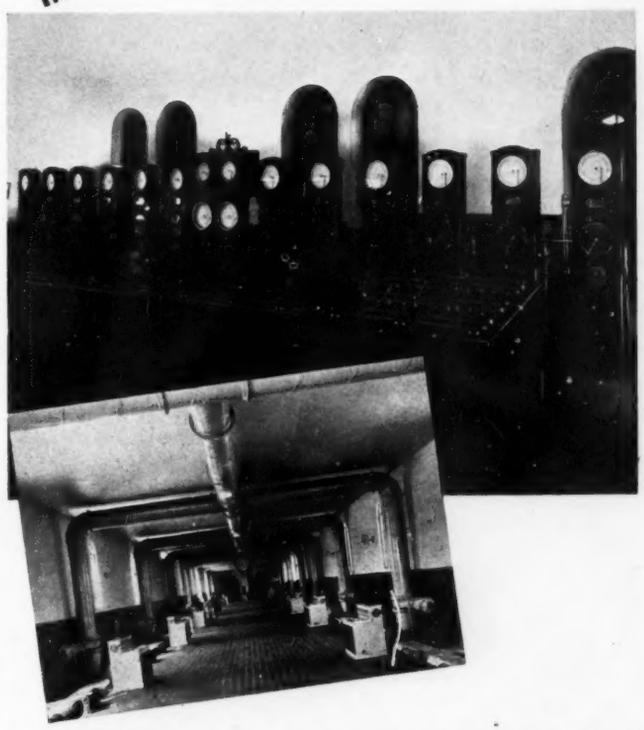
"Automatic Priming Equipment," for centrifugal pumps is described in a leaflet published by the De Laval Steam Turbine Co. In this system the water level on the suction side of the pump is automatically lifted above the eye of the impeller and held there, just as if the pump were located below the supply. The vacuum producing device is called upon thereafter only in the case of exceptional air inleakage, or when the pump is started again. The system described employs neither floats nor a central vacuum tank, and remains operative so long as electric power is available for the main pump motor. For a copy of Leaflet SP-1 write De Laval Steam Turbine Co., Trenton, N. J.

"Mixing Equipment and Filter-Bottom Balls" are presented in a very complete 96-page catalog from the Patterson Foundry and Machine Company of East Liverpool, Ohio, which firm has for 75 years been successfully building such equipment for use in the industrial fields. The catalog covers high speed propeller type (rapid mix) equipment in portable and stationary models; blade and paddle type mixers, complete with tank shells when desired. The catalog also shows the circular Patterson Thickener, with center shaft and scraper blade mechanism; also, rotary dryers of several types. Two pages are devoted to Patterson's Porox (acid proof tile), Linings for tanks, and Patterson's Porox Balls for ball-mills. These balls are used in the Wheeler type corrosion-proof filter bottom, which has received considerable attention since recent installations in several modern filter plants. For a copy of Patterson's complete Catalog No. 309, write Patterson Foundry and Machine Co., East Liverpool, Ohio.

"SMOOTH-ON Handbook of Repairs" is a ready reference booklet (1939 edition) which illustrates and gives procedures in making innumerable types of equipment and structural repairs, these having been contributed by practical men over the world. It is produced in simple, concise language and contains 170 diagrams (sketches) to picture the job and save many words. "Smooth-On" cements, available for iron, brass or bronze, aluminum, and concrete, are described and the proper grade is recommended for each repair illustrated. Some come in putty form, others as powder for mixing with plain water. Ideas in this little booklet will produce others, and every operator or mechanic should find it of use sooner or later when in need of a ready reference in an emergency or on some needed repair. For a copy write Smooth-On Mfg. Co., 568-574 Communipaw Ave., Jersey City, N. J.

Prevent wear and cutting of rods, plungers, shafts and valve stems by using
MABBS RAWHIDE PACKING
MABBS
In Your Water Works and Sewage Plants
IT LASTS LONGER—*Is Anti-Frictional, Saves Power, Labor, and Repairs. Will prove the cheapest packing that can be bought.*
Mabbs Hydraulic Packing Co.
Incorporated 1892
Trade Mark Reg. U. S. Pat. Off. 431 S. Dearborn St. Chicago, Ill. U.S.A.

BUILDERS Venturi
METERS & CONTROLLERS AT MONTREAL



VENTURI Type M Register-Indicator-Recorders stand, like sentinels on guard, behind the bench-board in the Chief Operating Engineer's room at the Atwater Main Pumping Station and at the McTavish Street Pumping Station.

Likewise, at the Filtration Plant, forty-eight 20" Venturi Rate-of-Flow Controllers have been giving satisfactory service for years, doing their bit to maintain Montreal's enviable record for producing pure water at low cost.

Visitors at the N.E.W.W. Association Convention will be interested in these "working exhibits" and in the display of other Builders Venturi and Chronoflo Equipment at our booth. Engineers in attendance will be glad to discuss the application of this equipment to your needs.

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A LESSON IN OLD-FASHIONED ECONOMY

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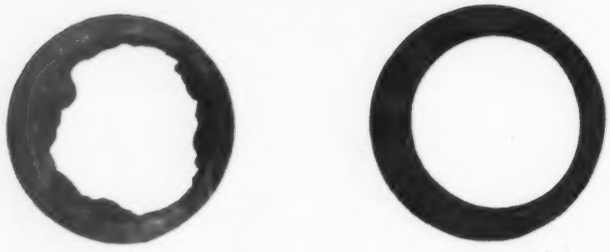

By use of water-propelled or cable drawn machine, tubercles, incrustations and deposits are removed. Shutoff of water is only from five to seven hours, at night if desired.

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GOOD NEWS FOR TAXPAYERS

A 42.6% saving in coagulant costs in treating the municipal water supply of a midwestern city of nearly 9,000 population was good news to taxpayers . . . and feathers in the caps of city officials.

In six months, ending May 13, 1938, the cost of alum as a coagulant was $2.65 per million gallons of water treated. For the same period of 1939, the use of Ferrisul cut the cost to $1.52 per million gallons, a saving of $1.13. In addition, Ferrisul solved a trying problem of turbidity.

Ferrisul, anhydrous ferric sulfate, is an all-purpose, all-year coagulant for treating water or sewage. Effective over the entire pH range above 3.5, it delivers a quick-forming, rapidly settling, stable floc. Ferrisul, easy to store and handle, frequently brings annual savings equal to many times the cost of the new equipment it may require.

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for water and sewage treatment

For complete Ferrisul facts and assistance on your coagulation problems, write MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston, Massachusetts.

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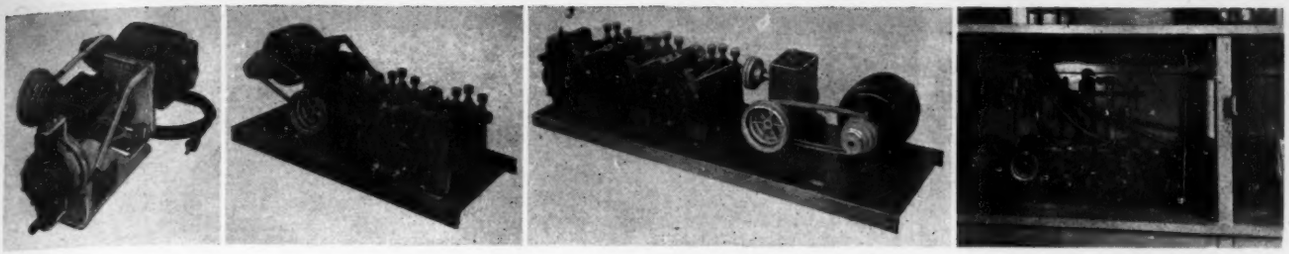

Midget, for feeding ONE chemical | Duplex, for feeding TWO chemicals | Triplex, for feeding THREE chemicals | Quadruplex, for feeding FOUR chemicals

"Speaking of Operations"

To most water plants, chlorination used to appear as a "major operation"—the town council, selectmen, and trustees had to approve this considerable expenditure. Then, installation and operation had to be mastered. Frequently, chlorination was "put off until later."

Now, %Proportioneers, Inc.% have made chlorination a "minor operation." Financially, a Chlor-O-Feeder is so low in price that the Superintendent can usually buy it on his own requisition. Technically, it is so simple that 90% of our customers install their own Chlor-O-Feeders, using instruction book furnished (although service men are available in all parts of the United States and in Canada).

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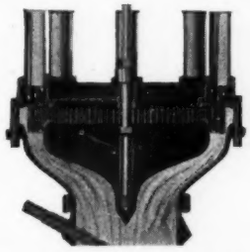
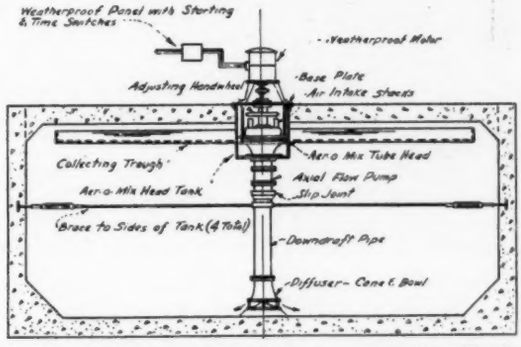


Cross section of Aer-O-Mix aspirator tube head and throat.

For outside or inside installation. Non - freezing. Gravity (head loss) type; Rotary (motor - driven—no head loss) type; Pressure type; Self-contained, closed unit type. For use in water treatment plants; sewage treatment plants; industrial waste treatment, etc. A six-point method involving diffusion, compression, retention, expulsion, surface contact, agglomeration.



Section Through Typical Sewage Aeration Tank Showing Aer-O-Mix Downdraft Aerator.

As a mechanical aerator in the Activated Sludge Process in Sewage Treatment—as well as for auxiliary aeration in trickling filter and other processes for municipal and industrial waste treatment—the Rotary Aer-O-Mix Downdraft Aerator has several features that appeal to both Designing Engineer and Operating Engineer. These include—positive control and measurement of air input—easy access to adjusting mechanism—slip-joint construction for ready inspection and maintenance. The construction is exceptionally sturdy and materials throughout are selected for maximum resistance to corrosion.

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WATER CONDITIONING PLANTS

IN SERVICE OR UNDER CONSTRUCTION BY JULY 1939

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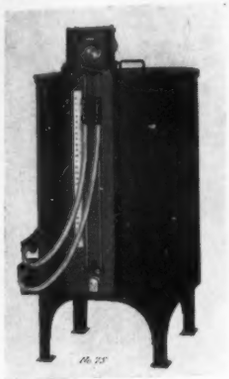
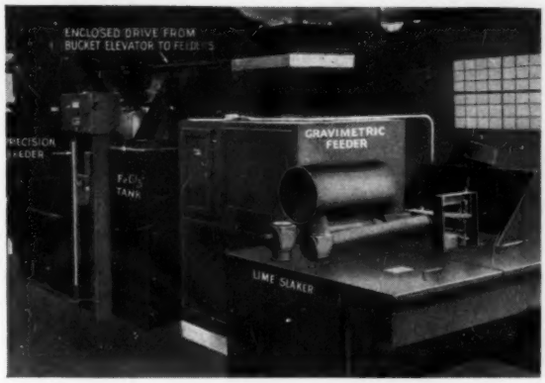
OMEGA CHEMICAL FEEDERS . . . IN THIS COMPLETE LINE OF DRY AND SOLUTION TYPE FEEDERS THERE IS THE RIGHT TYPE FOR EACH JOB



Precision Feeder with rubber lined tank for Ferric Chloride, Hypochlorites, etc. Electric spring motor or line shaft drive optional. Tank capacities from 25 gal. to 400 gal. with empty-tank alarms are standard. Automatic proportional controls are available.

Right—Belt Gravimetric Feeder for Quicklime and Precision Feeder for Ferric Chloride in Cleveland, Ohio, Sewage Treatment Plants driven by sludge elevator to obtain proportional feed.



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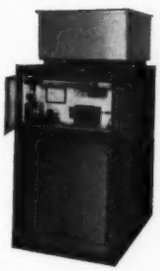

Left — Gravimetric Feeder with 2,000 lb. self-contained hopper on scales. Mixing chamber enclosed. Illuminated scale beam. Capacities 1 lb. to 2,000 lbs. per hour.

Right — Rotodip Meter (Archimedes Wheel type Feeder) — 1 gal. to 600 gal. per hour.

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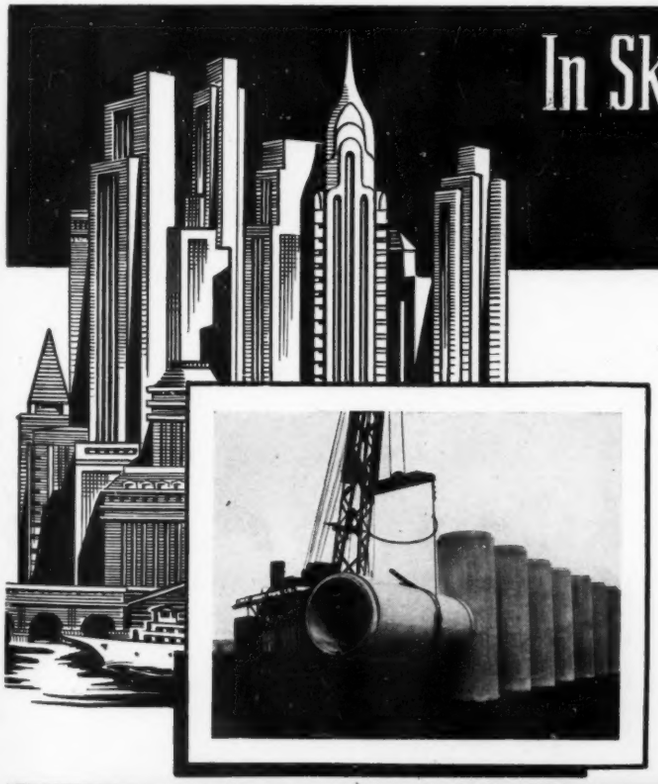

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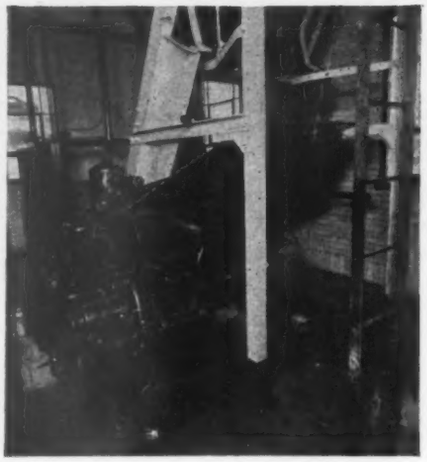

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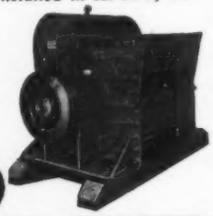

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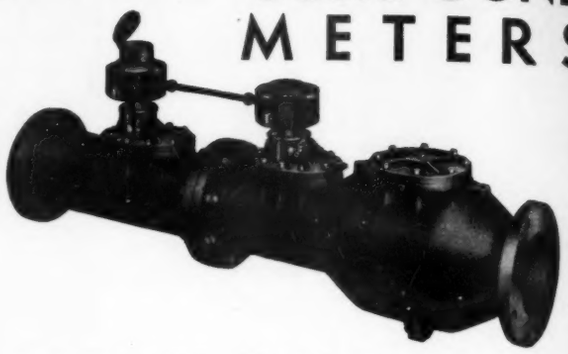

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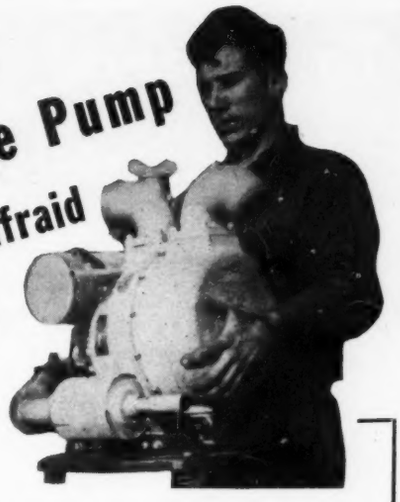

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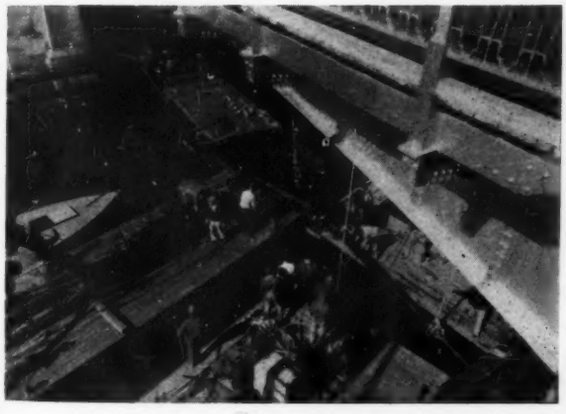

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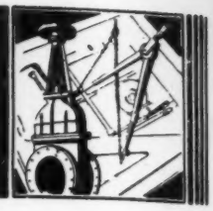

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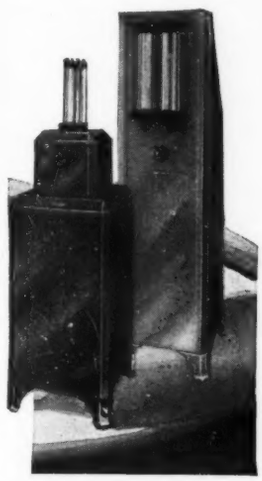

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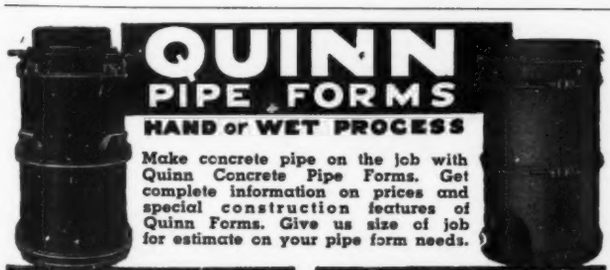

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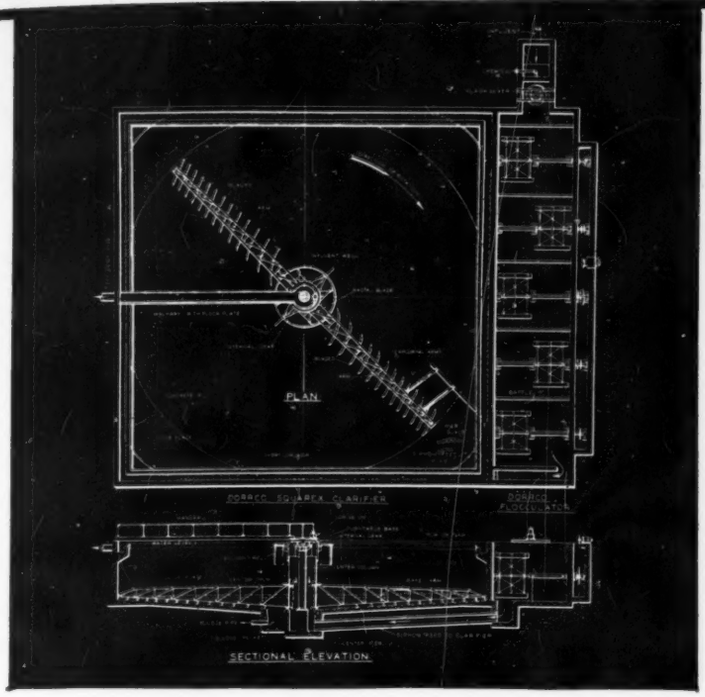
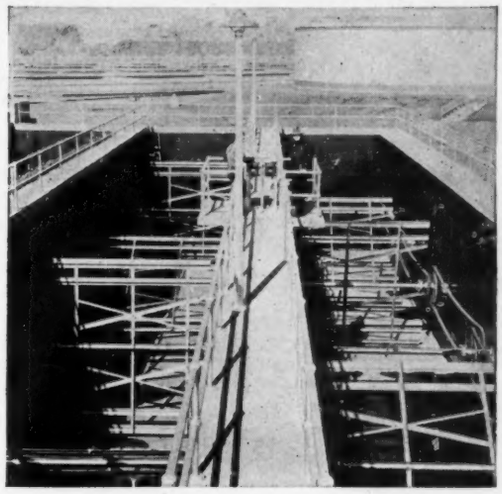
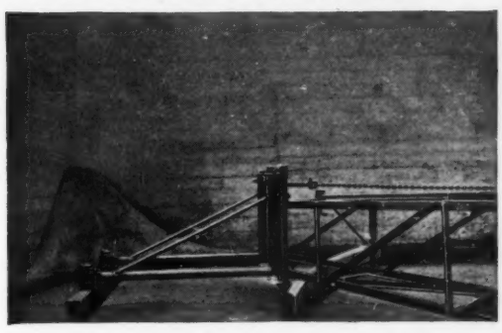
RATE RECORDER FOR WATER METERS

Something New in SEDIMENTATION





The Flocculation Compartment



The corner Exploring Arm of the Dorr Squarex Clarifier

Central feeding siphon, baffle and rigid arms, of the Dorr Sifeed Clarifier

Chemical precipitation has demonstrated the value of flocculating the treated sewage prior to sedimentation.

More recent investigations have shown that flocculating raw, untreated sewage ahead of sedimentation tanks, without the use of chemicals, pays for itself in terms of a greater overall capacity or an improved effluent.

This new Dorr sedimentation unit has been developed to meet these two trends in sewage treatment practice.

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Chemical diffusion in a Dorrco Flash Mixer—Conditioning in a Dorrco Flocculator—Sedimentation in a Dorr Squarex Clarifier.

Three steps in a single compact structure.

For Raw Sewage Sedimentation

Pre-conditioning in a Dorrco Flocculator—Sedimentation in a Dorr Squarex Clarifier.

Two steps in one structure.

DORRCO

For a complete and detailed description, write for our new Dorr Clarifier Bulletin.

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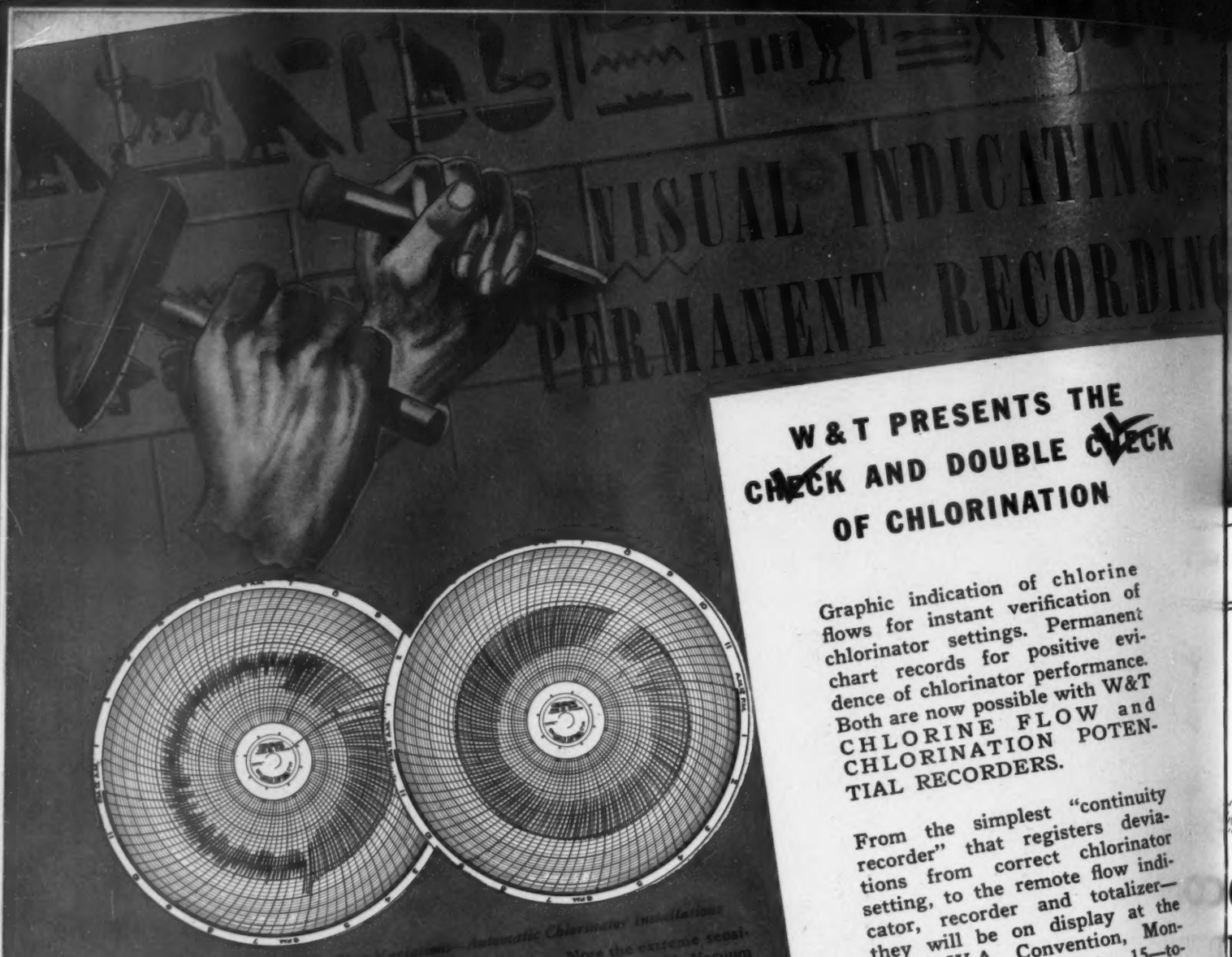

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Graphic Recording of Chlorine Flow Variations—Automatic Chlorinator Installations

These charts are taken from actual field operating apparatus. Note the extreme sensitivity with which the recorder follows the changes in flow from W&T Visible Vacuum Automatic Chlorinators installed where fluctuating water flows and pumpage entail frequent automatic adjustment of chlorinator rate of feed.

Graphic Recording of Chlorine Demand Changes

This chart records the amount of chlorine fed to maintain a constant chlorination potential of a supply with changing flows and changing chlorine demands.

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